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INSTRUMENTS

INDUSTRIAL — SCIENTIFIC

Devoted to the Instrument Problems of all Industries

Vol. 1. No. 4 Pittsburgh, Pa. April 1928

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RICHARD P. BROWN, PHILADELPHIA, PA.

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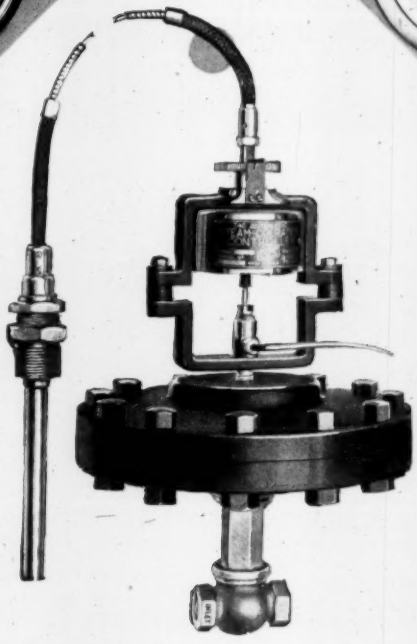

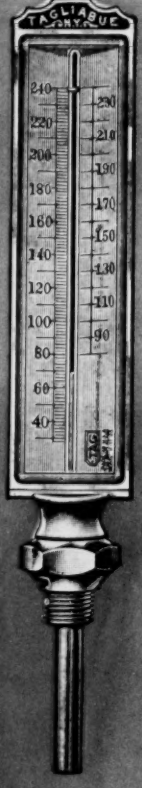

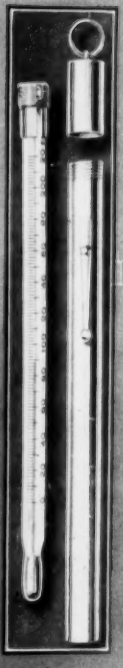

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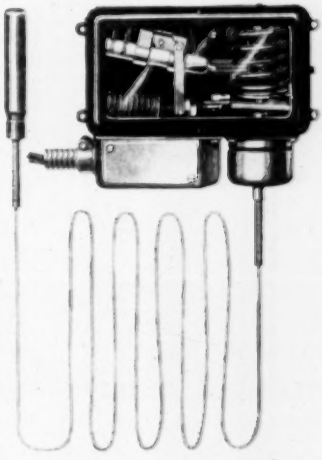

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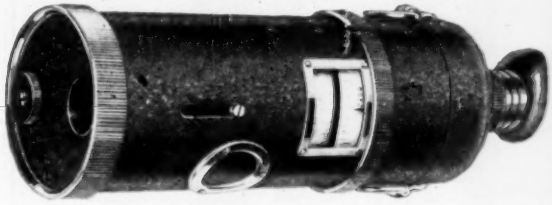

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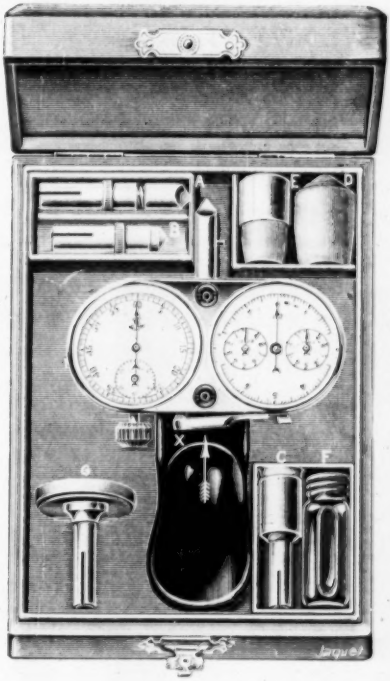

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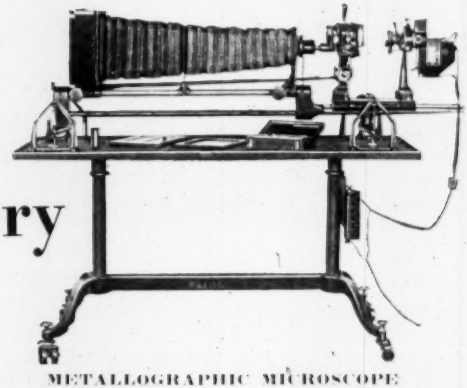

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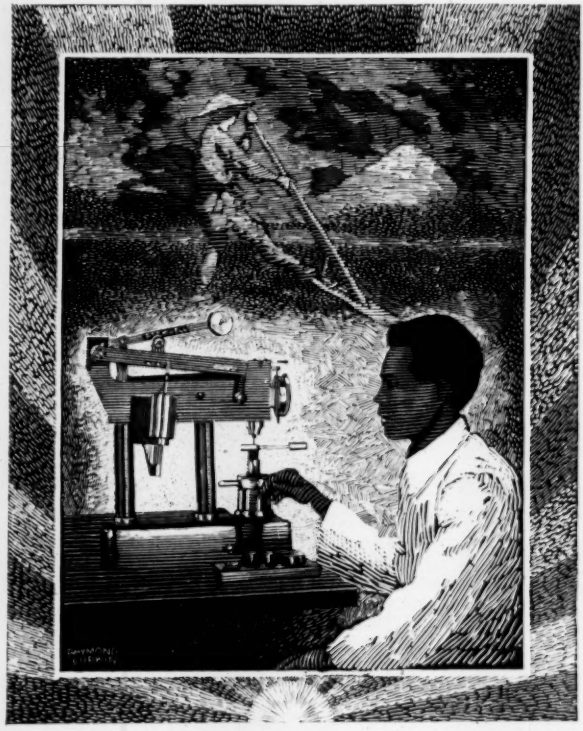
Have your stenographer cut out and file the 3 x 5 cards found bound in the back of this issue, listing the principal articles. They will direct you to valuable information to which you may wish to refer in the future.



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INSTRUMENTS

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Vol. 1. No. 4 APRIL 1928 Pittsburgh, Pa.

To Our Readers

INDUSTRIAL and scientific progress is both rapid and continuous. No one, however broad his professional contact and opportunities for observation can through his own efforts, keep adequately informed regarding all the new developments in the field of instruments.

The most effective means of keeping thoroughly informed is to read of the experience of others. When read understandingly the experience of others become almost as valuable as our own. The mass of current literature is so great that no one man can personally read or examine any large part of it.

Last month the editor began a detailed discussion of the various sections of INSTRUMENTS, and took up the file card section, which is bound in the back of every issue of the journal. This month the Current Literature Review will be the subject of discussion.

The periodicals which contain information on instruments are numbered by hundreds and each adds something to the sum of human knowledge. The Current Literature Review performs a distinctly valuable service as it segregates and summarizes the current literature in the field of industrial and scientific instruments.

The abstracts in the Current Literature Review contain enough information to indicate clearly the character of the article, thus enabling the reader to decide whether he is justified in examining the original article or not. Sufficient information is given on each reference so that the reader who wants complete details can identify the original article and examine it at his leisure. If the original is not available, INSTRUMENTS will furnish him with photostats or translate the article if in a foreign periodical. Estimates of the cost of such service will be furnished by the Readers' Service Department.

The Current Literature Review is of more than temporary value. It is printed on one side of the sheet, which permits cutting out the individual abstracts and pasting them on 3x5 file cards. A subject which is of casual interest today may in the future become important. These abstracts pasted on file cards in conjunction with the INSTRUMENTS' file cards will constitute a valuable guide to the available literature on instruments.

If you are anxious to receive this service each month, be sure to send us your subscription immediately. Subscription blanks will be found bound in the back of this issue.

Our New Collaborators

WE below list the names of three new men who have offered to cooperate with the editor by contributing information on the instrument developments in their particular field.

Prof. K. J. de Juhasz, Experimental Engineering, University of Minnesota, Minneapolis, Minn.

E. S. Lincoln, Consulting Electrical Engineer, New York, N. Y.

Prof. Tynan, Assistant Head of the Physics Department and Director of the Seismic Station at Fordham University, New York, N. Y.

Articles by these men will appear in future issues of INSTRUMENTS.

January Issues Not Available

WE have received a large number of requests and subscriptions asking for the January issue. We are sorry that it is not possible to comply with these requests, as we at present have a waiting list of over 300 who want the first issue. In answer to our appeal last month to those who do not intend to save the January and February issues we have received no January issues and about 300 copies of the February. Of these latter number 150 were immediately used. Therefore all new subscribers should clearly state on the subscription blank if they want to start with the February issue as this will not be done unless requested to do so.

Postal Regulations

IT was called to our attention by the Post Office Department that our subscription blank contained a sales message and therefore when placed in the book loose, conflicted with the Postal Regulations. This notice was received too late to print a new subscription blank and we are therefore binding the subscription blank into the back of the book to comply with the Regulations.

Therefore if you desire to pass the blank along to one of your friends, kindly remove it from the back of this issue.

Instruments for the Measurements of Electrical Insulation

A COMMENT on this article which appears in the February and March issues of INSTRUMENTS was received too late to print in the March issue. It will be found in the Reader's Comment Section.

Why Not Build Aircraft Instruments?

THIS article is intended as a plea to manufacturers to get busy. There are only a few aircraft instrument manufacturers in this country and there is room for many more reliable concerns. The Army Experimental Station at Wright Field, is always glad to furnish information and to test new instruments. Inquiries should be addressed to

Experimental Engineering Section, Wright Field,
Dayton, Ohio.

Mr. Jones emphasizes the need for dependable instruments. This need has been made especially plain by experince to date. A recent example is given in the note dropped by Chamberlain and Williams during their attempt to establish a new world's endurance record. We quote this note as printed on January 14th in the *Pittsburgh Post-Gazette*.

> "Our tale of woe."
> "Thirteen hundred revolutions per minute, oil 68 pounds, 122 degrees, altitude, 1,000," the note reported. "Had lots of fun last night. First, gas leak in cockpit. Then rate of climb indicator broke. Tank indicator sticks in certain positions and turn indicator is so sluggish can make complete turn without it registering."

The article was given to manufacturers of aircraft instruments on our mailing list for comment and in the Reader's Comments Section will be found a letter which we received.

American Oil Burner Association Announces Tests to Determine Uniformity for Guidance of Oil and Burner Manufacturers.

UNIFORM specifications for the guidance of oil and burner manufacturers and dealers have just been announced by the American Oil Burner Association. These specifications are the result of research, tests, correspondence and conferences carried on over two years. The American Petroleum Institute and the American Society of Testing Materials cooperated in the work, and the specifications adopted have received practically unanimous approval by the members of the American Oil Burner Association.

In announcing these specifications, Harry F. Tapp, Technologist of the American Oil Burner Association, points out that one of the greatest variables in installations has been non-uniformity of oil. This probably has been more responsible for lack of satisfactory operation than any other one cause. Burner manufacturers found it difficult to explain just what oil they wanted, and oil refiners were in doubt as to the needs of the manufacturer of burners. The oils used have been generally satisfactory and trouble has been due, in the main, to occasional variations.

The first step in solving this problem was the appointment by the American Oil Burner Association of a committee which made a survey with the cooperation of the American Petroleum Institute. Committee D2 of the American Society of Testing Materials was also asked to make a tentative specification form. Specifications of nearly one hundred oils were examined and tabulated, including almost every type of oil on the market and representing almost every locality. Tentative results were submitted to the oil burner and fuel manufacturers and to the Underwriters' Laboratories, and the criticisms received proved useful in determining the final specifications.

The specifications apply to six types of oil, including light, medium and heavy grades of furnace oil used in domestic heating, and light, medium and heavy grades of fuel oil for industrial use. The requirements cover flash point, amount of water and sediment, distillation range, and viscosity.

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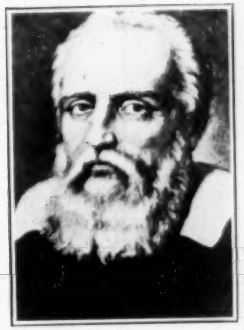

Instrument Pioneers

Galileo Galilei
(1564-1642)

GALILEO GALILEI was born at Pisa, on February 18th, 1564. He was the oldest in a family of five children born to Vincenzo Galilei, a Florentine noble, and Giulia Ammanati, who also belonged to an ancient family.

Notwithstanding his illustrious birth and descent, it would seem that the home in which the great philosopher's childhood was spent was an impoverished one. It was obvious at least that the young Galileo would have to be provided with some profession by which he might earn a livelihood. From his father he derived both by inheritance and by precept a keen taste for music. He was also endowed with considerable artistic power. It would seem that for some time the future astronomer entertained the idea of devoting himself to painting. His father, however, decided that he should study medicine. At seventeen, we find that Galileo, having added a knowledge of Greek and Latin to his acquaintance with the fine arts, was duly entered at the University of Pisa.

At college, Galileo became an ardent student of philosophy. Until he was twenty he was scarcely acquainted with the rudiments of mathematics, because his father thought this study was a waste of time for a man who was to become a physician. He secretly studied mathematics with intense interest.

It appears that kneeling at prayer in the Cathedral of Pisa, Galileo's attention became concentrated on a chandelier which hung from the ceiling. The oscillations were at first considerable, but as they grew less and less, Galileo observed that they were all performed in the same time, measuring the time by feeling his pulse. The idea occurred to him that an instrument could be constructed which should mark the rate and variation of the pulse. He began to experiment, and soon invented the pulselogia, which the physicians hailed with great delight.

The talents of Galileo having at length extorted due recognition from the authorities, he was appointed, at the age of twenty-five, Professor of Mathematics at the University of Pisa. To demonstrate in the most emphatic measure the absurdity of the doctrine that Aristotle had asserted, that the time occupied by a stone in falling depends upon its

weight, he let fall from the overhanging top of the Leaning Tower of Pisa a large heavy body and a small light body simultaneously. In the sight of a large concourse of people the fact was demonstrated that the two bodies fell side by side, and reached the ground at the same time.

The feeling became so strong against the investigator that after three years at Pisa he resigned. Through the active exertions of his friends, Galileo then was elected to the Professorship of Mathematics at Padua, whither he went in 1592. It was in this new position that he entered on that marvellous career of investigation which was destined to revolutionize science.

Galileo had a remarkable aptitude for the invention of instruments designed for philosophical research. To facilitate his practical work, we find that in 1599 he engaged a skilled workman to live in his house, and began to superintend the making of the compass which he had invented. Among the earliest of his inventions appears the thermoscope, or heat indicator, which he constructed in 1602, which led in later years to the thermometer. His experiment was made with a "glass bottle about the size of a hen's egg, the neck of which was two palms long, and as narrow as a straw. Having well heated the bulb in his hands, he placed its mouth in a vessel containing water, and on withdrawing the heat of his hand from the bulb, the water instantly rose in the neck, more than a palm above the level of the water in the vessel."

With all the pressure upon Galileo for money, due to the death of his father, the demands of his sister's husbands for the payment of their dowries and the worthlessness of his brother, he kept steadily on in his absorbing studies. He heard that Hans Lipperhey of Germany, had invented a spy-glass, and presented it to Count Maurice of Nassau, so that the principle of this optical instrument was understood; but nobody saw its practical applications until Galileo, hearing of the glass, began to reflect on the construction of an instrument to bring distant objects near. In a leaden tube, he fixed two lenses, both having one flat side, the other side of the one being concave and the other convex.

He hastened to Venice with his leaden tube to exhibit it to the Doge and the Senate. He perceived that the Doge desired to possess the instrument and presented it to him. In return for this he was elected to "professorship for life, with the stipend of one thousand florins yearly." The remarkable properties of the telescope immediately commanded universal attention among intellectual men. He received requests from several quarters for his new instrument, of which it would seem that he manufactured a large number and distributed them as gifts to various illustrious personages.

It was reserved for Galileo himself to make that application of the instrument to the celestial bodies. On his return to Padua, he began to eagerly study the heavens. He found that the surface of the moon was mountainous; that the Milky Way was composed of an immense number

of small stars and nebulous matter; that Orion, instead of being made up of seven heavenly bodies, had over five hundred stars; and that the Pleides were not seven, but thirty six. In January, 1610, he discovered the four moons of Jupiter, and that they revolved around him. July of the same year, he discovered the ring of Saturn; in October, the phases of Venus, and later the solar spots.

Galileo now longed for freedom from teaching, that he might have his time for study and writing. With considerable work in mind, he resigned the professorship at Padua, and removed to Florence, the Grand Duke Cosmo II giving him a yearly salary and the title of Mathematician and Philosopher to His Highness.

While in Padua, Galileo had three children by Marina Gamba, a Venetian woman of inferior station. She afterwards married a man of her own class. The two daughters were placed in the Franciscan Convent of St. Matthew at Arcetre while still scarcely more than children. The elder daughter, Polissena, took the name of Sister Maria Celeste, while the younger, Virginia became Sister Arcangela. The latter seems to have been delicate and subject to melancholy, and is of little account in this narrative. Sister Maria Celeste, though never leaving the convent, managed to preserve a close intimacy with her father. While Galileo's visits were very irregular and infrequent, they corresponded frequently. His greatest comfort during his life was this daughter. The son, Vincenzo, was educated for the profession of medicine, but he seems to have been a disappointment and a source of discomfort.

In 1611, his expenses paid by the Grand Duke, Galileo went to Rome to show his "celestial novelties" as they were called, to Pope Paul V and the Cardinals. He was received with great attention, and all seemed delighted to look upon the wonders of the heavens, provided always that nothing could be proved against the supposed assertion of the Bible that the earth did not move.

Four years later, he was again in Rome to plead for the Copernican system and to defend his own conduct in advocating a thing in opposition to the Catholic Church. He was duly admonished by Cardinal Bellarmine on February 26, 1616 that he was on no account to teach or defend the obnoxious doctrines. Galileo was much distressed by this intimation. The same year, he had an interview with the Pope. He was assured that he would have no further trouble with the Church so long as Paul V was in the chair of St. Peter.

On the death of Paul V in 1623, Maffeo Barberini was elected Pope as Urban VIII. At Easter, 1624, Galileo, now sixty years old, resolved to proceed to Rome, to welcome the new Pope, and urge his approval of the Copernican theory. Frail in health, he was carried most of the way in a litter. During the visit of six weeks, he had six long audiences with Urban VIII; but, though he was affably received, the Pope was in no wise convinced, but rather tried to convince Galileo that he was in error.

Galileo returned to Florence with the hope that he could bring out his great work "The Dialogue of the Two Systems," without opposition from the Church. It was ready for publication in March, 1630, but to be sure that there would be no objection, he again went to Rome and presented the matter to Urban, who gave his consent provided certain conditions were complied with. Rather than forego the publication, he consented and returned to Florence. A license to publish was then obtained but further deliberations delayed the issue for two years.

Other anxieties came to the man of sixty-eight, besides the long delay. His brother sent his wife, seven children and a nurse to the home of Galileo to be taken care of. The oldest nephew was sent to Rome to study music, but was found to be obstinate, impudent and dissolute. His son Vincenzo had married and brought his wife home to live. His one gleam of light was the daily letter from his daughter Maria Celeste. Finally he moved to Arcetri to be near her.

In January, 1632, the "Dialogues" appeared and in October of the same year, Galileo was summoned to Rome to answer the charge of heresy. On January 20, 1633, the decrepit old man set out in a litter for Rome, arriving on February 13. On April 12, he was brought before the Inquisition, briefly examined and remanded to prison though treated with great leniency. On April 30 he was led a second time before the Inquisition. Weak, aged, in fear of torture he confessed his "error." On May 30, he was summoned a third time and given eight days in which to write his defence. A fourth time he came before the inquisition on June 21 when he retracted his belief in the Copernician system, and then on June 22 in the presence of cardinals and prelates he heard his sentence. He was condemned to imprisonment in the Holy Office during the pleasure of the Papal authorities, and that he should recite once a week for three years the seven Penitential Psalms. On July 9, he was allowed to leave Rome for Sienna, where he stayed five months in the archbishop's house, and then became a prisoner in his own house at Arcetri.

Maria Celeste died April 1, 1634, at thirty-three years of age, leaving Galileo heart broken. The very day of his daughter's death came the final decree directing him to remain in his own house in perpetual solitude. Amid the advancing infirmities of age, the isolation from friends, and the loss of his daughter, Galileo once again sought consolation in hard work. He completed his famous "Dialogue on Motion" in the summer of 1636 and sent it to Leyden for publication. Gradually, however, his sight began to fail, and blindness was at last added to his other troubles. His last work was a short treatise on the secondary light of the moon. He planned other work, but death came on the evening of January 8, 1642, with his beloved pupils, Torricelli and Viviani, and his son at his bed-side.

Why Not Build Aircraft Instruments?

*Bradley Jones, Dayton, Ohio**

TO any of the readers of this article who are manufacturers, it is desired that they give some thought to entering a new field. Only a few companies now build instruments suitable for airplane use and the need for instruments is increasing daily.

During the war, large quantities of instruments were manufactured, and the armistice found the Government with a large stock on hand. While reserving a large portion of this stock for its own use, the Government sold many hundreds of these surplus instruments to jobbers and these men in turn disposed of the instruments to owners or builders of airplanes for civilian use.

At the present time this supply of "war-stock" instruments is practically exhausted. The Government Depots are depleted and the supply of equipment for civilian-owned airplanes has become scanty.

Another phase should be presented. When the Wrights and Curtiss flew their first primitive planes, their only flying instrument was a rag tied to a strut. This served as a crude airspeed indicator, for if their speed was slow the rag hung limply, but as their speed increased the rag streamed out more nearly horizontally astern.

Later on, an oil-pressure gage was added to give the pilot a warning of impending engine failure. With time other instruments were added, a compass, a more reliable airspeed indicator, etc., until at the close of the war, seven instruments were to be found in front of the pilot.

Since 1918, many changes have taken place in flying. Longer distances are flown non-stop and engines are more reliable, so that pilots need no longer follow a round-about path along railroads, but can cut directly across country to their destination. Pilots are flying at night, in fogs and in storms. They are starting off in such weather that a decade ago even the boldest would not venture to leave the ground. This means that additional instruments are needed as guides and aids, and today a well-equipped instrument-board shows eleven instruments.

Lest one might think that the field is small, or that the Government is the only consumer as regards airplanes, it should be noted that in the first eleven months of 1927, a total of 2353 airplanes were built of which 700 were for the Army and Navy. This means there were 1653 built for civilian use. In 1926 there were 1186 planes manufactured of which 636 were for civilians. In 1927 the exports of airplanes were valued at

*Engineering Division, War Department Air Service.
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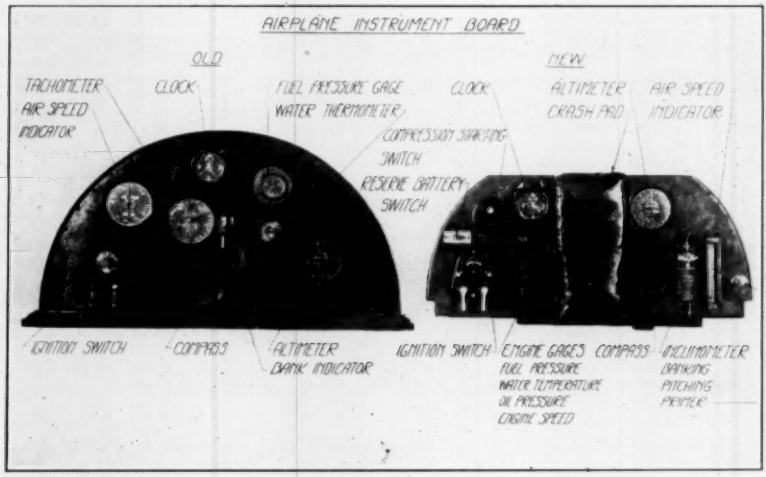

On left—Instrument Board of 1918. On right—Instrument Board of 1926. Courtesy Army Air Corps.

$800,000; of engines $500,000; of equipment $500,000. At the close of 1927 there were 103 companies building airplanes of which barely a dozen were contractors for the Government. The above figures are taken from a Department of Commerce Report and are the most authentic available.

The growth of civilian aeronautics is reasonable and healthy. Every day more people are realizing that safety in aviation is on par with the safety of other modes of transportation. Once converted and having participated in the thrills of air travel they will not be content with the slower prosaic modes of transportation.

Nowadays the usual method of airplane construction is to stretch cotton cloth over a metal. While it is desirable to renew the fabric every year or so, the airplane itself is good for many years.

While the big selling field for instruments is for installation in new airplanes, it is expected that the life of an airplane will be longer than the serviceable life of the instruments and it may be reasonably assumed that new instruments will be needed for old planes.

Nowadays before being flown airplanes must be inspected and approved by Government officials. It is required by law that every civilian owned plane carry a tachometer and oil-pressure gage for each engine. If the engine is water-cooled, it must have a water thermometer; if air-cooled, it must have an oil-thermometer. The airplane must carry an altimeter and if it flies more than 100 miles cross-country, it must carry a compass. These are absolute requirements, but practically every airplane carries in addition an airspeed indicator.

For Army use, where it is customary in two-seater planes for it to

be possible to pilot from either seat, there is an altimeter, airspeed indicator and compass in the rear cockpit as well as in the front cockpit. For flying in fog, there is added a turn indicator and two inclinometers (fore-and-aft and lateral). Induction compasses are being used more and more in addition to the regular type where accurate navigation is required.

In the design of aircraft instruments the Army Air Corps has been guided by one basic principle. Civilian flyers are becoming convinced of the wisdom of this same rule. This creed may be summed up in four words: "Reasonable accuracy or stopped."

In automobile travel if the driver suspects engine trouble he pulls up at the side of the road and investigates; if he is lost, he stops and inquires. In airplane travel if engine trouble developes or if the pilot doubts his position, he must land. It is landing in small fields away from suitable airdromes that has caused many a mishap.

More and more is the flyer depending on his instruments, and it is better by far that the instrument register zero than to give a faulty reading that the pilot unknowingly will put his trust in, and thus lead himself to disaster.

Price is not the primary consideration. An instrument upon which a pilot cannot depend is worthless. Treachery cannot be forgiven. Aviators are willing to pay a fair price for instruments on which their lives and and livelihoods depend.

Instruments must be rugged to stand the vibrations and shocks encountered in use, but they are not expected to "live forever." Replacements are taken as a matter of course unless they come too frequently. Ruggedness as well as small bulk and light weight are matters to be taken care of in design.

Two decades have passed since man began to fly but aviation is still in its infancy. It is a good healthy infant and its growth is normal. Its growth in 1927 was a bit better than its growth in 1926. This present year will be better still.

Like the small boy whose idea of doing something big was to "wash an elephant," many people have recently become imbued with the idea of doing something big in aviation and to too many of them has it meant something physically like an airplane or an engine. Yet every airplane must be flown safely and every engine must be run properly and for this, instrumental equipment is necessary. To promote safety and efficiency is no small thing to achieve. A maker of instruments will do well to investigate the possibility of engaging in the manufacture of instruments for aircrafts. The field is far from being crowded. The competition of cheaply sold war-stock instruments has disappeared. Makers of reliable instruments can rightly expect a brilliant future in producing aeronautic equipment.

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A New High Speed Engine Indicator

*Kalman J. De Juhasz, Minneapolis, Minn.**

A NEW indicator developed by the author permits taking accurate pressure diagrams of internal combustion engines up to the highest speeds used in practice.

Until recently the lack of a suitable pressure indicator for use in development and research work on high speed internal combustion engines was keenly felt. Although there are several instrument types (such as the optical and micro indicators) available on the market intended for this purpose, these are seldom used owing to their inherent inaccuracy and comparatively low speed limit. Other instruments of later construction using balanced diaphragms and electric registration are rather cumbersome to install and inconvenient to operate, which necessarily limits their use to research laboratories.

Principle of the De Juhasz Indicator

The De Juhasz indicator draws a complete diagram during a series of successive cycles by means of a point by point method in such a way that each point of the diagram is obtained from a different cycle.

The essential feature of this instrument is a valve element driven by the engine under test. This valve is placed between the engine cylinder and the cylinder of an indicator, which is similar to the ordinary steam engine indicators. The valve element connects the two volumes for a very small fraction of each successive cycle, always in the same phase. The indicator piston will then assume a position within its cylinder, which corresponds to the pressure present in the tested phase of the cycle and records this pressure on the card. By changing the phase relation of the opening time of the valve to the phase of the engine crankshaft, a complete diagram of the engine cycle can be obtained. The change in phase relation is accomplished by a planetary gear device similar in its action to a differential gearing. By properly coordinating the timing of the valve to the indicator recording drum movement, the pressure can be recorded either as a function of the piston displacement or the crank angle. Since the speed of both moving parts, i.e., the indicator piston and the recording drum, is low the undesirable inertia errors are completely eliminated.

Since its inception in 1919 the instrument has been steadily improved to make it applicable to the constantly increasing engine speeds and pressures. Fig. 1, shows the latest type, which has been successfully used up to 6000 R.P.M.

*Engineering Experimental Station, University of Minnesota.

The instrument consists of the four main components: 1. The pressure measuring indicator arranged for this special purpose with external, easily interchangeable spring and interchangeable cylinder sleeves and pistons enabling the indicator diagrams to be taken with any suitable scale. It has the usual recording drum upon which the card is fixed.

2. The valve element, one outlet being connected to the engine cylinder and the other to the indicator cylinder by means of copper tubing. This connected to and driven by

3. The phase timing planetary gear whrich is in turn driven directly by the engine at half the engine speed by means of a chain or bevel gear drive. An additional rotary movement can be given to this gear by a hand crank which alters the phase under test. To this is attached

4. The drum actuating gear made up of a crank and connecting rod mechanism of variable geometrical proportions, from the crosshead of which the movement of the indicator drum is derived.

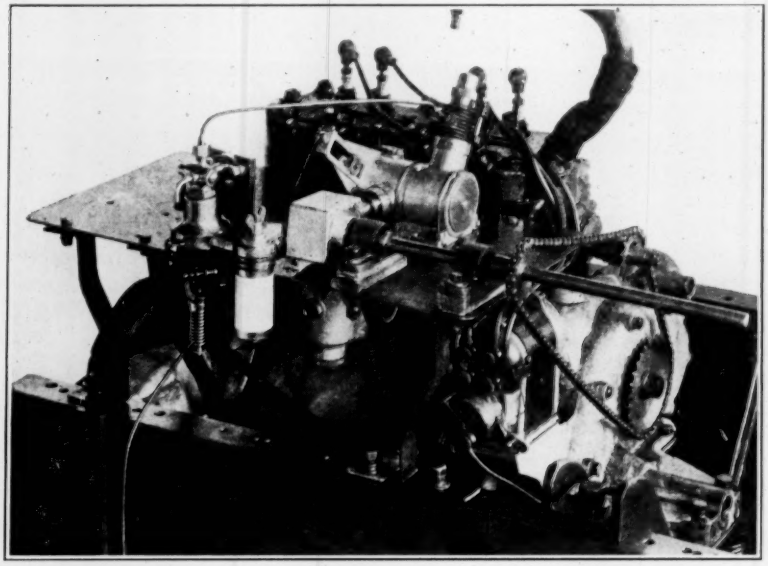

Fig. 1. De Juhasz High Speed Indicator applied to a Fiat Engine.

Parts 2, 3 and 4 make up a complete unit (shown in Fig. 2). Their relative positions can be interchanged to facilitate mounting the equipment on the different types of engines.

1. The engine indicator should be of the low speed type with interchangeable springs and pistons to enable both light and heavy spring diagrams being taken at a convenient scale. Thus the small pressure variations in the intake manifold or carbureter jet or the high pressures occuring in a Diesel engine can be measured with the same instruments.

This method eliminates the inertia errors so that a large indicator can be used, which will give a diagram of convenient scale and size.

2. The valve element consists of two cylindrical slide valves reciprocating inside an air cooled cylinder. The latter has two ports, one of which (M) is connected by a nippled tube of 1/8 inch internal diameter to the engine space to be tested, while the other (I) is connected by means of a 1/16 inch internal diameter tube with the pressure indicator. The two slide valves are set in motion through suitable connecting rods from a rotating crankshaft and in their center position (where their velocity is the largest) permit communication to take place between the parts M and I. This position is characterized by the upper ends of the slides being flush with each other and with the upper ends of the outer cylinder, which can be ascertained by screwing off the ribbed cylinder cap. In all other positions of the slides the connection between M and I is interrupted. While in use the slides have to be well lubricated with castor oil, which is poured into the valve casing through a hole under the cylinder cap.

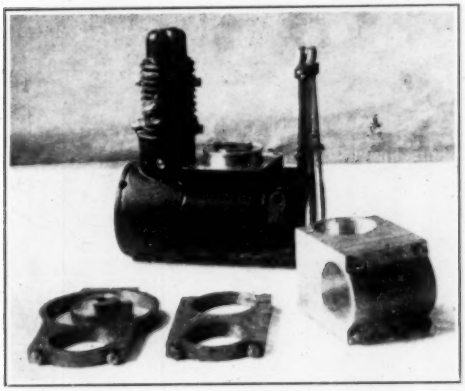

Fig. 2. New De Juhasz Indicating Outfit with fixing clamps.

It will be realized that for the satisfactory operation of the engine indicator, the design and workmanship of this valve is of the greatest importance since it is essential that it remain tight and resist wear under the difficult conditions of high speeds, temperatures and pressures.

The valve element can be dismantled by unscrewing four bolts in the casing. The upper and lower halves of the casing then come apart and the crankshaft together with the slides can be pulled out of the outer cylinder.

3. The phase-changing planetary gear is contained in a casing having three similar bosses. Out of these bosses protrude three similar shaft ends, provided with suitable driving dogs and centering holes by means of which the respective engagements can be effected. A primary shaft (marked 1) is driven by the engine under test at half the engine speed;

co-axially with it, is a secondary shaft (marked 2) engaging with and driving the crankshaft of the valve element, while the tertiary shaft is fixed or rotated by the worm drive of the drum actuating attachment described below. The design is such that the primary and tertiary shafts are interchangeable in the performance of their respective functions, in order to facilitate mounting the instrument on the different engine types.

In one case the one shaft may be more conveniently driven from the accessible engine shaft and in other cases the other.

The drive from the engine, in most cases, is effected by an ordinary roller or chain drive. In individual cases a direct drive from the cam

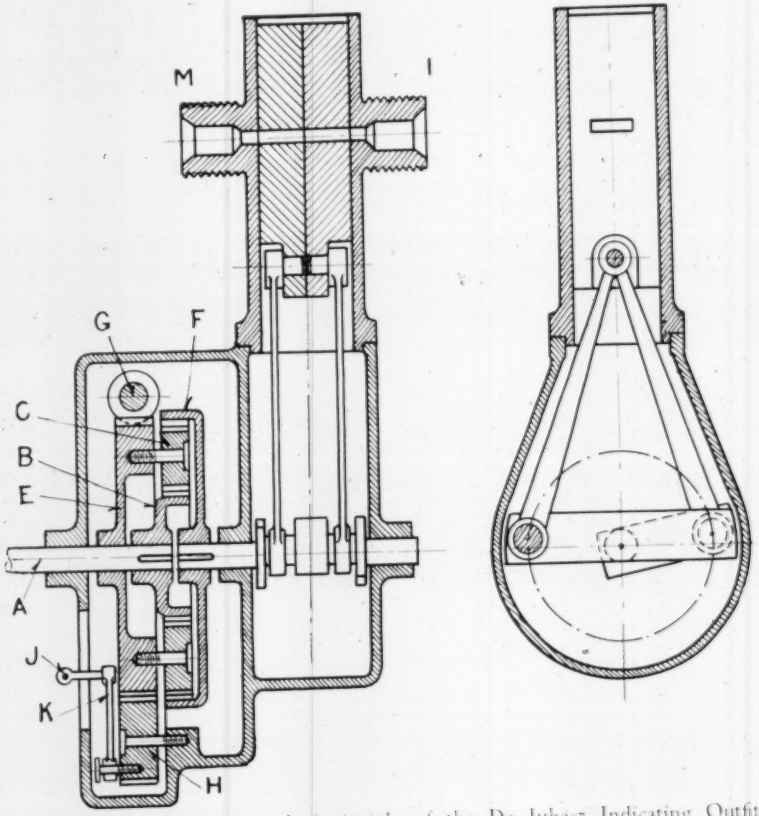

Fig. 3. Diagram illustrating the principle of the De Juhasz Indicating Outfit. Shaft A and spider wheel B driven positively from the engine tested: C planatory wheel: E wheel for changing the phase tested: G hand operated worm: F internal gear driving crankshaft of valve: H pinion: K and J connecting rod to which the indicator drum cord is attached.

shaft or a bevel gear drive may be found more suitable. In any case the drive must be such that the primary shaft (1 or 3 as the case may be) is driven at one-half the engine speed.

4. To the tertiary shaft (3 or 1 as the case may be) the indicator drum activating gear, containing a hand operated worm and gear drive and a crank-connecting rod mechanism, is attached. The mechanism of this attachment consists, in a similar manner to that of the valve element described above, of two parts fastened to the cylindrical base of the planetary gear by means of four bolts. The worm gear engages by means

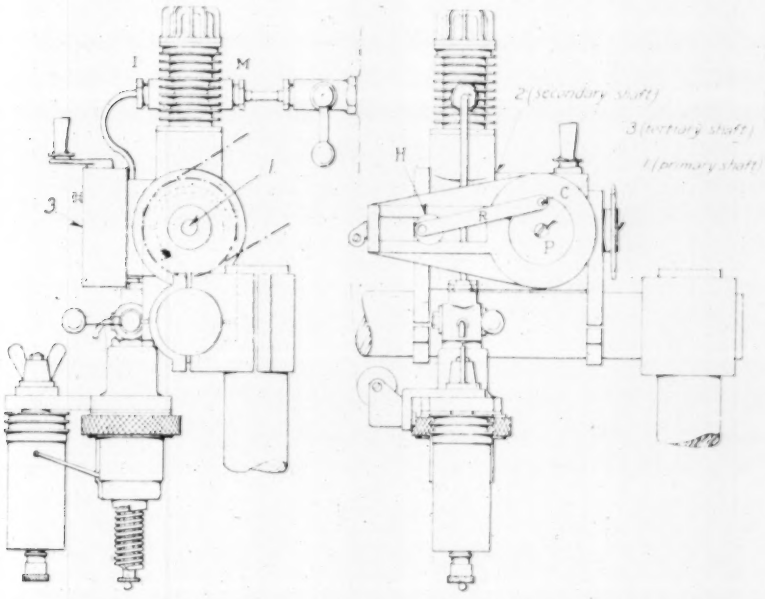

Fig. 4. Diagram showing the arrangement of the De Juhasz Indicating Outfit.

of suitable holes with the dog of the protruding tertiary shaft to which it is fixed by means of a central bolt. The phase disc centered on the worm gear carries a crankpin, which in conjunction with a connecting rod and crosshead arrangement actuates the indicator drum. The phase disc is geared to the worm wheel in such a gear ratio that the angle by which the disc is rotated corresponds with the angle alteration of the phase under test as measured on the engine crankshaft.

The movement of the indicator drum is obtained from the phase disc P (Fig. 4), on which a crankpin C, working together with the connecting rod R and crosshead H is arranged. The geometrical proportions (i.e., crank radius to length of connecting rod, and crank radius to offset) of this crank drive can be set so as to be equal to those present in the engine under test. Having accomplished this setting the movement of the crosshead will bear an exact ratio to the piston displacement corresponding to the phase tested.

The movement of the crosshead is communicated magnified, by means

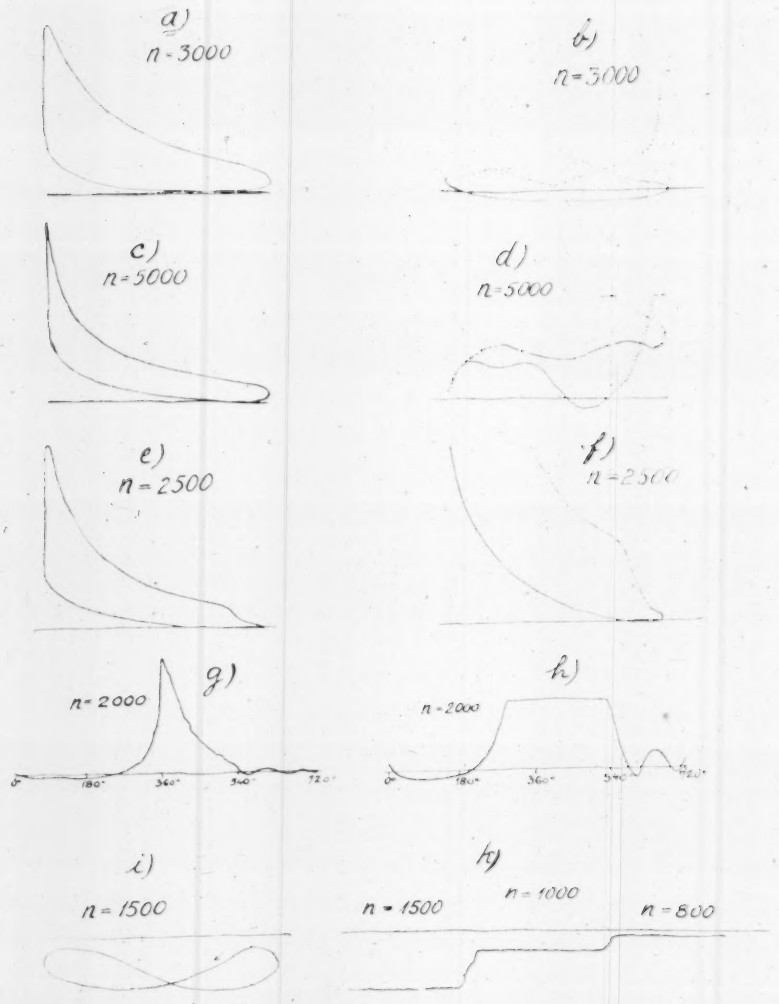

Fig. 5. Reproductions of cards taken with the De Juhasz Indicating Outfit.
(a) and (b) Heavy and light spring diagrams for a normal four cycle engine.
(c) and (d) Heavy and light spring diagram of a supercharged engine.
(e) and (f) Cards for a two cycle engine.
(g) and (h) Cards taken on a crank angle basis four cycle engine.
(i) Diagram taken with very light spring on the carbureter throat.
(k) Card taken on the intake manifold under different operating conditions of the engine, the phase under test being set at the lower dead center.

of a flexible cable or cord to the indicator drum which thus moves in exact proportion to the piston displacement of the phase under test.

If it is desired to obtain the pressure curve on a crank angle basis then instead of the crank-connecting rod drive, the drum must be fixed directly to the phase disc P and the drive of the indicator drum obtained in this manner by means of an endless string guided by suitably placed pulleys.

This method and apparatus presents the following advantages:

1. It can be used for testing all sorts of pressure phenomena, which repeat themselves in the same form, as a function of a rotary movement or time. Thus it permits investigating the cylinder space, intake and exhaust manifold of all kinds of internal combustion engines. With its aid the pressure phenomena can be recorded as a function of the piston travel or crank angle or also the variation of the pressure valve of any selected phase can be recorded as a function of time or another variable. For internal combustion engines or any other type as well as for pumps and compressors this apparatus gives diagrams enabling an accurate analysis of the performance.

2. It is entirely mechanical in its action. It is of rugged construction and can withstand the every day usage in the plant and test room. The indicator diagram can be drawn of any desired size in the same simple manner as in the case of an ordinary slow speed indicator.

Sources of error due to the inertia of moving indicator parts or high temperatures are completely eliminated. It is easy to apply and simple to operate. With reasonable care there is nothing to get out of order.

3. Weak and heavy spring diagrams can be taken one after another or even simultaneously. The accuracy of the diagram is equal to those taken with the normal indicator on a slow speed engine. In cases where exceptionally high sensitivity is required a very sensitive pressure gauge or liquid column can be used in place of the indicator.

4. If desired the engine can be tested under normal operating conditions even on a running automobile or an airplane in flight. A special advantage is that the recording part of the apparatus can be placed at a distance from the engine under test.

5. The diagrams do not represent one cycle, but an average value during several hundreds of revolutions.

6. It can also be used for special purposes, such as taking gas samples corresponding to a definite phase of the cycle; recording the pressure of one definite phase i.e., compression or intake pressure, under changing conditions, etc.

7. It is light in weight (the valve assembly weighing about 3 lbs.), of small overall dimensions and can easily be applied to any type engine.

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The Part Scientific Instruments Play In Our Lives

Richard P. Brown, Philadelphia, Penna.

IN the past 25 years, we have witnessed tremendous progress in the development and perfection of mechanical devices which increase our comfort and convenience and it is reasonable to assume that the next 25 years will see even greater developments. While it was invention which primarily gave us the new appliances, it is largely due to scientific measuring instruments that we have seen such great improvement in their design and manufacture.

Nowhere is this exemplified to a greater extent than in automobiles. Compare the automobile of twenty years ago with that of today. True the modern car has better lines and better equipment, but the real reason automobiles are so much more satisfactory today is in the elimination of the great amount of trouble formerly experienced.

Anyone who owned one of the early cars can recollect the anguish used by broken springs or axles, broken crank shafts, worn out bearings, breaks in ignition wires and the comparatively short life of the tires.

It has been due largely to the development of special alloy steel and the proper heat treatment of this steel that springs, crank shafts and axles so rarely break now-a-days. The substitution of alloy steels to obtain increased strength as compared with ordinary steel, could not of itself obtain this result, for the best alloy steel if annealed or heat treated at an improper temperature could give no better service than ordinary steel. So pyrometers were developed and improved for the purpose of very accurately measuring the precise temperatures required in heat treatment of alloy steels.

Many motorists today remember when an automobile owner was well satisfied to get three or four thousand miles from a tire. Today we expect 10,000 miles or more. In part this has been accomplished by improvement in the materials from which the tires are built, but it is largely due also to automatic temperature regulators which control the vulcanizing process in order that exactly the proper temperature is automatically maintained throughout this treatment.

To make our automobiles go, gasoline is needed and as the use of automobiles grew, a greater gasoline yield was necessary. If we had gone on making gasoline the way we did fifteen or twenty years ago, the cost of gasoline today would be out of sight on account of its scarcity. It was the demand for gasoline that necessitated the development of improved cracking stills in which the gasoline yield was largely increased. These stills work under much higher temperatures and exceedingly high pres-

sures. On account of the increased danger of explosion and fires, extremely accurate instruments for regulating the temperature and the high pressures become essential. In the modern still, the oil passes through the tubes in the still at pressures as high as 800 pounds or more per square inch with an oil temperature of about 850°F. and a temperature in the fire box below the tubes of 1450°F. In some stills it is found that if this fire box temperature is increased to 1500°F. burnouts may develop, resulting in disaster, danger and loss.

Furthermore, if it is found that a temperature of 875°F. is the proper temperature for the hot oil to leave the still, a materially smaller yield of gasoline will be obtained if 870°F. is maintained. It would be physically impossible to operate the modern cracking still without accurate scientific instruments for measuring temperature and pressure. Were it not that these instruments have been developed and are available, we could not obtain the supply of gasoline which is available today.

When we travel on the railroad, do we ever stop to consider that all parts of the cars and locomotives which have been found to break readily, such as couplings, crank shafts, and driving shafts, are now accurately heat treated at the proper temperature to obtain the greatest strength from the steel, resulting in increased safety in railroad travel.

The development of the airplane is equally linked to the need for accurate instruments. The airplane motor of today could not have the life it does if it were not for instruments used in heat treatment of the parts, and the pilot would be unable to operate or guide the plane were it not for his instruments on the instrument board.

In the development of any new appliance it is necessary to compare with it, the article formerly used, and no comparison could be obtained without means to measure the characteristics of each device. Progress is founded on scientific measurements essential in perfecting any improved article.

Our modern power plant which produces light, heat and steam for many purposes, is far more efficient today than formerly. This increased efficiency could not have been obtained without means of measuring all the factors involved in boiler and engine performance; and it would be impossible to regulate the modern power plant if there were no instruments on the switchboard to guide the operator.

In the manufacture of automobiles, if the pyrometers used in treating the steel should fail to function, manufacture would have to cease until the instruments were again operating. The modern still producing gasoline would have to shut down if for any reason the instruments ceased operation. The modern airplane would have to land or crash under similar conditions and the modern power plant would shut down until the measuring instruments were put in order. Do we ever stop to consider the part scientific measuring instruments play in our modern life?

Uniform Fuel Oil Specifications of the American Oil Burner Association

Oil No. 1

Name

FURNACE OIL—LIGHT

Scope

1. This specification covers a light distillate oil for use in burners where a high grade fuel is required.

Properties

2. This oil shall conform to the following requirements: it shall be a hydrocarbon oil free from water, acid, grit and fibrous or other foreign matter likely to clog or injure the burner or valves.

(*a*)	Flash Point:	
	Minimum—Legal or (Pensky-Martens Closed Tester)	110°F.
	Maximum—(Pensky-Martens Closed Tester)	165°F.
(*b*)	Water and Sediment, maximum	Trace
(*c*)	Pour Point, maximum	0°F.
(*d*)	Distillation Test:	
	When 10 percent has been collected in the receiver the thermometer reading shall not exceed	420°F.
	The end point shall not be higher than	600°F.

Methods of Testing

3. The properties enumerated in these specifications shall be determined in accordance with the following methods of test of the American Society for Testing Materials, except as specified in Paragraph (*a*).

(*a*) Flash Point:

Minimum—The instrument and method for determining minimum flash point shall be that legal for the locality in which the oil is sold. In absence of legal requirements the minimum flash point shall be determined in accordance with the Standard Method of Test for Flash Point by means of the Pensky-Martens Closed Tester (Serial designation D 93).

Maximum—Standard Method of Test for Flash Point by means of the Pensky-Martens Closed Tester (Serial designation D 93).

(*b*) Water and Sediment:

Standard Method of Test for Water and Sediment in Petroleum Products by Means of Centrifuge (Serial designation D 96).

(*c*) Pour Point:

Tentative Method of Test for Pour Points of Petroleum Products (Serial designation D 97-27 T).

(*d*) Distillation Test:

Standard Method of Test for Distillation of Gasoline, Naphtha,

Kerosene, and Similar Petroleum Products (Serial designation D 86).

Oil No. 2

Name

FURNACE OIL—MEDIUM

Scope

1. This specification covers a grade of or distillate oil for use in burners where a high grade fuel is required.

Properties

2. This oil shall conform to the following requirements: it shall be a hydrocarbon oil free from water, acid, grit and fibrous or foreign matter likely to clog or injure the burner or valves.

(*a*) Flash Point:
Minimum—Legal or (Pensky-Martens Closed Tester) ..... 125°F.
Maximum—(Pensky-Martens Closed Tester) ..... 190°F.
(*b*) Water and Sediment, maximum ..... Trace
(*c*) Pour Point, maximum ..... 0°F.
(*d*) Distillation Test:
When 10 percent has been collected in the receiver the thermometer reading shall not exceed ..... 440°F.
When 90 percent has been collected in the receiver the thermometer reading shall not exceed ..... 620°F.

Methods of Testing

3. The properties enumerated in these specifications shall be determined in accordance with the following methods of test of the American Society for Testing Materials, except as specified in Paragraph (*a*).

(*a*) Flash Point:
Minimum—The instrument and method for determining minimum flash point shall be that legal for the locality in which the oil is sold, in absence of legal requirements the minimum flash point shall be determined in accordance with the Standard Method of Test for Flash Point by means of the Pensky-Martens Closed Tester (Serial designation D 93).
Maximum—Standard Method of test for Flash Point by means of the Pensky-Martens Closed Tester (Serial designation D 93).

(*b*) Water and Sediment:
Standard Method of Test for Water and Sediment in Petroleum Products by Means of Centrifuge (Serial designation D 96).

(*c*) Pour Point:
Tentative Method of test for Pour Points of Petroleum Products (Serial Designation D 97-27 T).

(*d*) Distillation Test:
Tentative method of Testing Gas Oils (Serial designation D 158-25 T).

Oil No. 3

Name

FURNACE OIL—HEAVY

Scope

1. This specification covers a grade of oil generally known to the trade as light fuel oil intended for general industrial consumption, and for use in burners where a medium grade low viscosity fuel is required.

Properties

2. This oil shall conform to the following requirements: it shall be a hydrocarbon oil free from water, acid, grit and fibrous or foreign matters likely to clog or injure the burner or valves.

(*a*) Flash Point:
Minimum—Legal or (Pensky-Martens Closed Tester) ..... 150°F.
Maximum—(Pensky-Martens Closed Tester) ..... 200°F.
(*b*) Water and Sediment, maximum 0.1%
(*c*) Pour Point, maximum ..... 0°F.
(*d*) Distillation Test:
When 10 percent has been collected in the receiver the thermometer reading shall not exceed ..... 460°F.
When 90 percent has been collected in the receiver the thermometer reading shall not exceed ..... 675°F.
(*e*) Viscosity, Saybolt Universal at 100°F.
Maximum ..... 55 seconds

Methods of Testing

3. The properties enumerated in these specifications shall be determined in accordance with the following methods of test of the American Society for Testing Materials.

(*a*) Flash Point:
Minimum—The instrument and method for determining minimum flash point shall be that legal for the locality in which the oil is sold. In absence of legal requirements the minimum flash point shall be determined in accordance with the Standard Method of Test for Flash Point by means of the Pensky-Martens Closed Tester (Serial designation D 93).
Maximum—Standard Method of Test for Flash Point by means of the Pensky-Martens Closed Tester (Serial designation D 93).

(*b*) Water and Sediment:
Standard Method of Test for Water and Sediment in Petroleum Products by Means of Centrifuge (Serial designation D 96).

(*c*) Pour Point:
Tentative Method of Test for Pour Points of Petroleum Products (Serial designation D 97-27 T).
The maximum pour point shall be 0°F. except for localities where the average temperature between October 1st and May 1st is 40°F. or above in which case the pour point may be plus 15°F.

(*d*) Distillation Test:
Tentative method of Testing Gas Oils (Serial designation D 158-25 T).

Oil No. 4

Name

FUEL OIL—LIGHT

Scope

1. This specification covers a grade of oil generally known to the trade as light fuel oil intended for general industrial consumption. It is for use in burners adapted to a medium grade, medium viscosity fuel.

Properties

2. This oil shall conform to the following requirements: it shall be a hydrocarbon oil free from water, acid, grit and fibrous or other foreign matters likely to clog or injure the burner or valves.

(*a*) Flash Point:
Minimum—(Pensky-Martens Closed Tester) ..... 150°F.
Maximum—(Pensky-Martens Closed Tester ..... 250°F.
(*b*) Water and Sediment, maximum 1.0%
(*c*) Pour Point, maximum ..... 15°F.
(*d*) Viscosity, Saybolt Universal at 100°F. maximum ..... 125 seconds

Method of Testing

3. The Properties enumerated in these specifications shall be determined in accordance with the following methods of test of the American Society for Testing Materials:

(*a*) Flash Point:
Standard Method of Test for Flash Point by Means of the Pensky-Martens Closed Tester (Serial designation D 93).
(*b*) Water and Sediment:
Standard Method of Test for Water and Sediment in Petroleum Products by Means of Centrifuge (Serial designation D 96).
(*c*) Pour Point:
Tentative Method of Test for Cloud and Pour Points of Petroleum Products (Serial designation D 97-27 T).
(*d*) Viscosity:
Standard Method of Test for Viscosity of Petroleum Products and Lubricants (Serial designation D 88).

Oil No. 5

Name

FUEL OIL—MEDIUM

Scope

1. This specification is similar to and covers a grade of fuel oil listed in the United States Government Specifications as Bunker Fuel Oil "B". It is suitable for burners adapted to low grade oil of medium viscosity.

Properties

2. The oil shall conform to the following specifications: it shall be a hydrocarbon oil free from grit, acid and fibrous or other foreign matters likely to clog or injure the burner or valves. If required it shall be strained by being drawn through filters or wire gauze of 16 meshes to the inch. The clearance through the strainer shall be at least twice the area of the suction pipe and the strainers shall be in duplicate.

(*a*) Flash Point:
Minimum (Pensky-Martens Closed Tester) ..... 150°F.

(*b*) Water and Sediment, maximum 1.0%

(*c*) Viscosity, Saybolt Furol at 122°F. maximum ..... 100 seconds

Methods of Testing

3. The properties enumerated in these specifications shall be determined in accordance with the following methods of test of the American Society for Testing Materials.

(*a*) Flash Point:
Standard Methods of Test for Flash Point by Means of the Pensky-Martens Closed Tester (Serial designation D 93).

(*b*) Water and Sediment:
Standard Method of Test for Water and Sediment in Petroleum Products by Means of Centrifuge (serial designation D 96).

(*c*) Viscosity:
Standard Method of Test for Viscosity of Petroleum Products and Lubricants (Serial designation D 88).

Oil No. 6

Name

FUEL OIL—HEAVY

Scope

1. This specification is similar to and covers a grade of fuel oil listed in the United States Government Specifications as Bunker Fuel Oil "C". This oil is suitable for burners that are adapted to a low grade of fuel oil of high viscosity.

Properties

2. The oil shall conform to the following specifications: it shall be a hydrocarbon oil free from grit, acid and fibrous or other foreign matters likely to clog or injure the burner or valves. If required it shall be strained by being drawn through filters or wire gauze of 16 meshes to the inch. The clearance area of the suction pipe and the strainers shall be in duplicate.

(*a*) Flash Point:
Minimum—(Pensky-Martens Closed Tester) ..... 150°F

(*b*) Water and Sediment, maximum 2.0%
Sediment, maximum 0.25%
A deduction in quantity will be made for all water plus sediment

in excess of 1.0 percent.

(c) Viscosity, Saybolt Furol at 122°F. maximum ..... 300 seconds

Methods of Testing

3. The properties enumerated in these specifications shall be determined in accordance with the following method of test of the American Society for Testing Materials:

(a) Flash Point:
Standard Method of Test for Flash Point by Means of the Pensky-Martens Closed Tester (Serial designation D 93).

(b) Water and Sediment:
Standard Method of Test for Water in Petroleum Products (Serial designation D 95-27) (U.S.G.S.S. Method 300.11) U. S. Government Standard Specification Method 300.2 for Sediment.

(c) Viscosity:
Standard Method of Test for Viscosity of Petroleum Products and Lubricants (Serial designation D 88).

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Dependence upon accurate measurement in the various lines of professional and industrial activity today has brought an ever increasing demand for precision instruments used in working out technical problems, in promoting efficiency of industrial operation and in facilitating the advance of science and the arts.

The total value of scientific instruments manufactured in 1925 is placed by the Department of Commerce at $72,386,890, an increase of 23.9 per cent over 1923. This report, however, does not include microscopes and other optical instruments nor does it include the output of manufacturers not engaged primarily in instrument making. The value of all scientific instruments produced annually in this country probably averages more than $100,000,000 at the present time.

Bakelite materials are used in almost every electrical instrument because of their dielectric strength which does not deteriorate with time and because of special properties promoting quantity production and satisfactory performance.

The great demand for instruments of all kinds used in scientific work and in professional and industrial activity has necessitated the employment of facilities for mass production. For this reason, molding of parts, from tiny screws and bushings to large cases with a hundred metal inserts in place, has been generally adopted. Bakelite resinoid molding materials are used in this operation.

Accuracy in construction is essential in any instrument of precision. The resinoid, laminated with reinforcing layers of canvas, linen, or paper, can be tooled to the right dimensions. Bakelite molded products require no machining, being molded in a single operation to fit exactly and retain their shape permanently. There is no warping, nor expansion and contraction from temperature changes.—*Bakelite Information.*

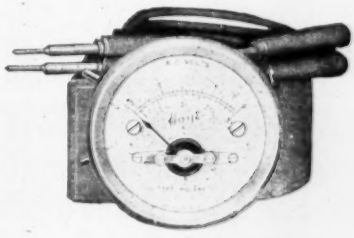
New Instruments

Recently Developed by Instrument Manufacturers

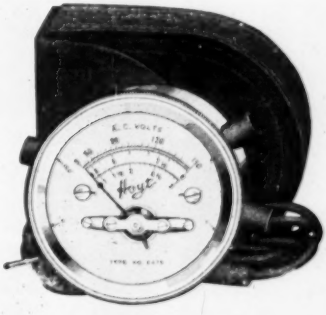
Hoyt Pocket A. C. Voltmeters

(Hoyt Electrical Instrument Works)

THE radio broadcast receiver of today has become a piece of power equipment. The volume and tonal fidelity required by the average listener means constant voltage for plate supply and plenty of reserve power at all times, which can only be obtained conveniently from the regular lighting mains. This means rectification, correct filtering, and



above all, careful adjustment of all power devices to the receiver at the time of installation or servicing.



Unfortunately, line voltage is not uniformly constant in different localities at any time, nor does it always remain the same in the same place at all times. Voltage variation must be taken into account and compensated for when radio equipment is installed and serviced by the radio

dealer or service man, and adequate means for determining line voltage conditions are necessary.

For this purpose Hoyt has developed a new line of A.C. Voltmeters which cover the voltage readings that must be made by the radio dealer or service man. These voltmeters are supplied in small cases (2¼ inch diam.) complete with test leads all packed in substantial leather cases that fit the pocket. A line voltage scale of 150 volts (with multiplier for 300 if desired), low scale from 1½ to 7½ volts or a combination of these can be obtained at a very reasonable cost.

While because of the small size of the instrument, the voltmeter with both high and low ranges is necessarily not for continuous use. The sensitivity or internal resistance has been maintained at a high value—where the lowest scale of 3 volts is considered—over twenty ohms per volt. The resistance of the single high range, 150 volts, is well over 60 ohms per volt. This meter is of the continuous use type. In spite of their low cost, the moving systems are equipped with jewelled bearings and have hand-calibrated scales.

While this line of A.C. Voltmeters was developed for use in the radio trade, there is a broad field of usefulness in the electrical industry generally. Line voltage variation often causes trouble sometimes attributed to defects in electrical units, such as motors, pumps, household appliances, etc., that can only be run down by a knowledge of voltage conditions. Appliance salesmen, motor experts and all those who must have a check on voltage conditions, but whose work precludes their carrying a set of standard testing instruments all the time, have found such a meter as this indispensable.

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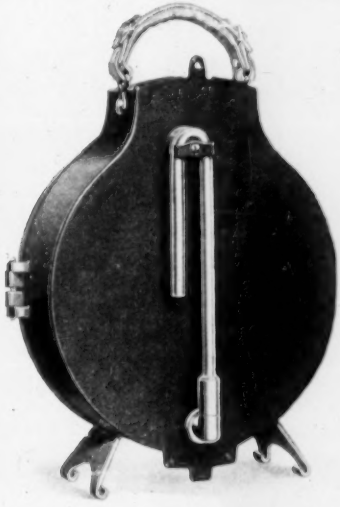
When Alexander the Great found he could not untie the famous Gordian knot, he cut it with his sword. This old story and the proverb, "There is more than one way to cook a goose," might well be inscribed on the walls of every engineer's office. The good engineer is always a man who can find another way when the customary routes are closed.

Tag Portable Recording Thermometers

(C. J. Tagliabue Mfg. Co.)

Self-Contained Type

THIS Tag Portable recording thermometer has been especially designed for use by automatic refrigerator manufacturers and other companies requiring a sturdy and accurate instrument which can readily be shifted from one location to another. The accompanying illustrations show its construction which, it will be noted, is *quite different* from that of other makes of self-contained recorders. Such instruments are usually enclosed in a perforated case, the sensitive bulb being located inside the case. This construction has been criticized because the mechanism (especially the clockwork) is exposed to moist air and to any injurious atmospheric conditions, and because it is impossible to get proper air circulation around the sensitive bulb when it is inside the case.



The Tag construction overcomes this by enclosing the inside mechanism in a moisture-proof case and by locating the sensitive bulb flat against the back of the case. This location of the bulb also secures a more immediate and more accurate response to temperature changes. A strong leather handle is furnished, and two substantial legs make a firm base for the instrument.

Above all it should be remembered that this Tag Recorder is of the mercury type, which is universally recognized as being the most accurate and rugged, especially for low temperature work. The construction of the instrument is identical to that used in Tag mercury instruments which have been adopted as standard by the leading oil refiners and other organizations where accuracy and durability are prime requisites.

Refrigerator manufacturers will particularly appreciate these facts as their use of this type of recorder for testing their own product naturally demands the best obtainable instrument.

Ranges: 0 to 110°F.
—40 to + 55°F.

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The value of a compass when one is out hiking in the wilderness is well shown in a recent incident which came near resulting in a tragedy. Albert S. Levenson, wealthy owner of a department store in Oakland, California, went to Richardson Springs, near Chico, Butte County, in the same state, where he sought rest and recreation as a relief from business cares. The quiet of the wilderness surrounding the resort was soothing, and daily he wandered alone through the Sierra foothills nearby. But one day he lost his sense of direction, and though he continued to walk all the following night, he could not find his way out, in spite of the fact that the sound of distant music could be heard. Unaccustomed to a pathless wilderness, and without a compass to indicate direction, he eventually became lost and helpless. As he was without scientific training, he could not determine direction from the sun by day, nor from the stars by night. At last he found an abandoned miner's cabin, where he collapsed from hunger and thirst. On the fourth day of his exile a rescuer, led by his faithful dog, "Tip," found the lost man unconscious on the floor of the cabin. When revived and brought back to civilization, his first remark was: "I'll never again go out into the wilderness without a compass. Every day I sell compasses to hikers and prospectors in my Oakland store, and yet I did not have sufficient foresight to take one with me on my vacation. I'll know better next time."—*Tycos-Rochester.*

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Many original tests which have a direct influence upon scientific progress are sponsored by government departments and private enterprise thus contributing to the development of new scientific instruments.

Rockwell Hardness Tester Model 3-H

(Wilson-Maeulen Company, Inc.)

THE Model 3-H Rockwell Hardness Tester departs from all previous models in having a heavier dead weight and fewer magnifying levers for impressing the standard Rockwell loads. The original Rockwell Tester had only a 2-inch verticle gap capacity, and the machine was used originally for laboratory work and for a certain amount of work in the

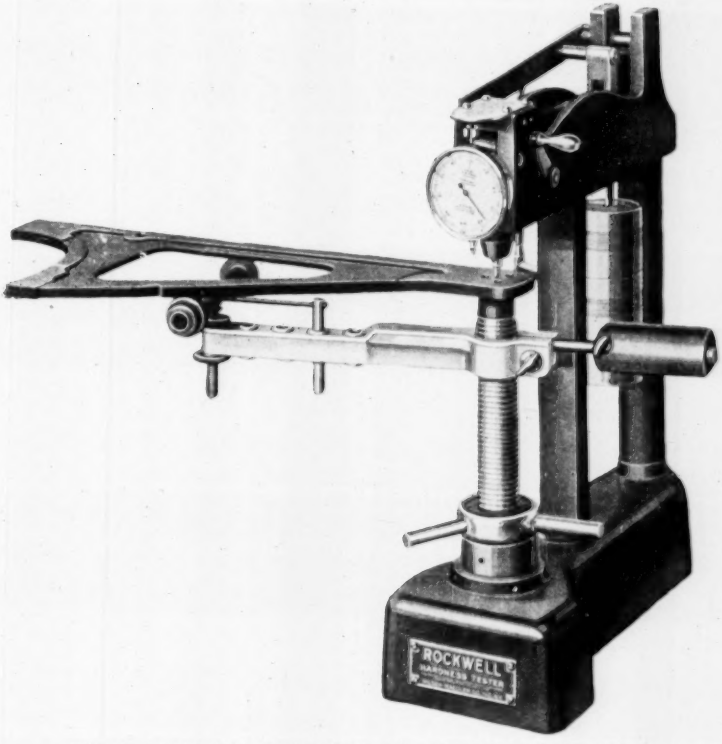

Fig. 1. Model 3-H Rockwell Hardness Tester with Vari-Rest.

shop, and was, in general, used as a semi-portable instrument. As machines were called for of greater vertical capacity the gap was increased without other radical changes being made. It has developed that the majority of testers required now are for industrial use, and where the machines are located in a single position, so that the semi-portable feature is

no longer a probable advantage in most plants, except sometimes in the case of the smallest size of machine. Heavier weights and fewer levers were therefore adopted believing that there is no longer any objection to a large total weight for the machine, and believing also that being used in industrial plants under conditions of dirt and atmospheric corrosion, especially in hardening rooms, the reduction of the number of levers and bearing points makes for simplicity in cleaning operations when the machines are cleaned from time to time. Absolutely no change is made in the standard loads applied by the tester and readings taken on "H" model machines check, therefore, with readings taken on any of the earlier models.

The Vari-Rest provides means for supporting either tubular or bar stock or long flat sheets and many irregular shapes with a support, which,

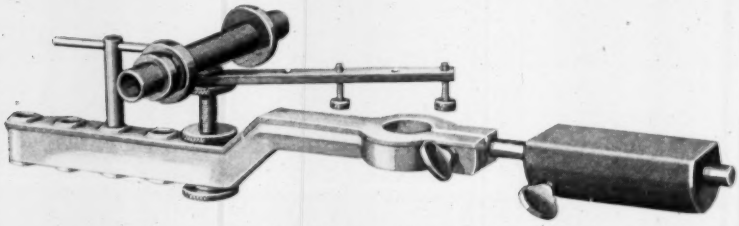

Fig. 2. Vari-Rest for use with smallest size tester.

being clamped to the elevating screw, goes up and down by the operation merely of the single capstan wheel employed for bringing the work up against the penetrator and carrying it up until the minor load has been applied. Fig. 1 shows the manner of supporting broad pieces which rest upon the spot anvil and upon the two collars of the Vari-Rest, one of these collars being eccentric so that its top elevation can be adjusted to slide with friction along the tube on which they are mounted. The Vari-Rest is constructed to provide a great many different adjustments, as will be evidenced from viewing the illustration.

Fig. 2 shows the Vari-Rest alone. This is designed for the smallest size tester.

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Accessories Division of American Radiator Company is moving its headquarters staff from Chicago to New York. On and after April 9th, 1928, their address will be 40 West 40th Street, New York City, where executive direction will center for manufacture and sales of Airid Air Valves, Arco Packless Valves, Arco Regulators, Mercoid Controls and their complete line of Ideal heating accessories.

Tapley Brake Testing and Performance Meters

(E. C. Cheswell)

THE Tapley Brake Testing Meter is an instrument for city and state official use. It is rather a difficult problem to measure all the factors involved in connection with brake testing. The stopping distance varies as the square of the speed, and a very slight error in the speed makes, of course, vital differences in the results. The brake testing meter is independent of the speed, being equally accurate at any speed above ten miles per hour.

The need for brake testing is most apparent when tests are made in communities where no standard has been fixed. Pleasure cars have been found with practically no braking power at all, and the same has been found with buses carrying a number of people. In Massachusetts, where more has been done with brake testing than in any other state, some

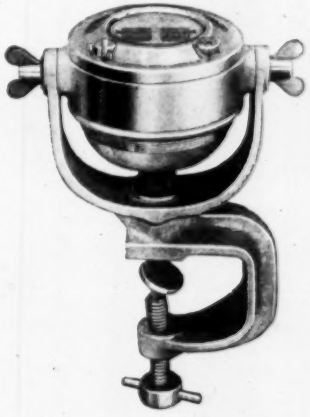

Fig 1. The Tapley Brake Testing Meter.

51% only of all the trucks could pass a lenient standard of safety. It is established that 50% of the deaths due to automobiles have been caused by faulty brakes.

Experts seem to agree that there will be some 40% more motor vehicles on the public highways in this country before the saturation point is reached. More attention must be paid to stopping vehicles, and the brake testing movement be well established before the greater number of cars add to the confusion.

The Tapley Meter is not only fundamentally accurate, but it is the only instrument which holds the scale at the correct reading and thus

eliminates the error of the operator in catching the maximum reading before the scale or pointer returns to its original position.

The Tapley Performance Meter shown in Fig. 2 gives the average car owner an opportunity of knowing something about the main features of the power equipment of his car so as to be able to get the maximum performance out of it. This instrument is also vital in keeping down the operating costs of trucks and buses.

This instrument gives the output of the motor vehicle in terms of net pounds pull. To state the horse-power of a motor car really gives little

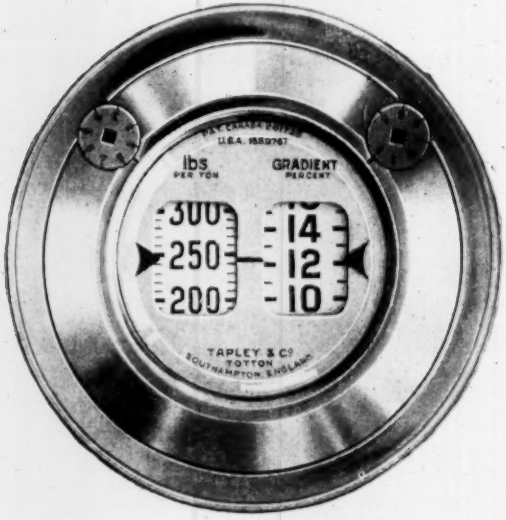

Fig. 2. The Tapley Performance Meter.

information of value, what the owner gets out of his car as a whole is what is important. The horse power is obtained only when the car is operated at its maximum speed, whereas the pounds pull rating gives the output of the car at normal speeds, the maximum pounds pull output being approximately at the speed of 20 miles per hour.

Rating motor vehicles in maximum net pounds pull output, is putting motor vehicles on the same standard in principle as when rating electric motors in maximum net horse power output, or electric generators in maximum net kilowatt output.

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"SUPER-INSTRUMENTS" FOR "SUPER-NEEDS"

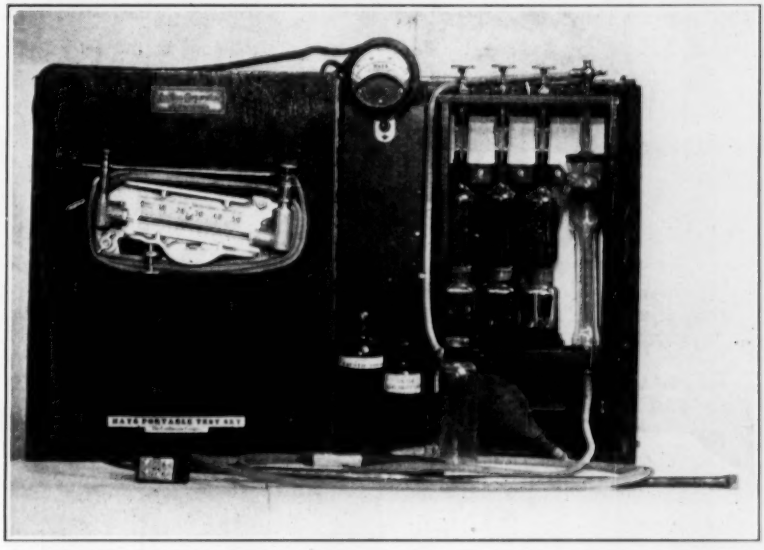
Philosophers tell us that the man satisfied with himself is going backward, and that a certain amount of "divine discontent" is required for progress.

New Hays Test Set "The Combustion Compass"

(The Hays Corporation)

THE idea has been to offer a simple and convenient case of instruments for service men, combustion engineers, oil burner dealers and others interested in the quick determination of combustion efficiency and the cause and location of boiler trouble.

This new Hays Test Set consists of flue gas analyzer, flue gas thermogage and draft gage compactly arranged in an oak carrying case. When the door and top of the case are swung open the instruments are ready for use. The analyzer is the standard Hays Gas Analyzer, either single chamber style for carbon dioxide only, or three-chamber style for carbon dioxide, oxygen and carbon monoxide. A CO_2 test can be made with this instrument in thirty seconds and a complete determination in less than four minutes. The analyzer may be removed from the carrying case and hung on a nail driven in the wall if it is desired to make a draft test at one point and a flue gas analysis at another point. The draft gage, which is mounted on the inside of the door, is of the inclined tube type with a micrometer screw for levelling. The scale is movable for convenience in setting the zero opposite the end of the oil column and a needle valve is provided to lock the oil in the oil well while the set is being



transported. The scale has a range of one-half inch water column but an auxiliary spirit level can be added to increase the range to one inch, the scale reading to be multiplied by two when the auxiliary level is employed. The thermo-gage is a small portable indicating pyrometer with the necessary lead wire and special alloy thermo-couple. This instrument has a pointer which indicates the temperature at the tip of the thermo-couple. For flue gas a range 75° to 1200° Fahrenheit is recommended but a 75° to 2500° F. range can also be supplied if higher temperatures are to be measured. As an alternative for the thermo-gage a metal armored thermometer, range 100° to 950° F. can be supplied.

The case measures only 6½ x 11 x 17 inches high and can be slipped into an automobile or underneath the seat of a train. The total weight is less than 20 pounds.

With this testing kit it is possible to make a complete check of the efficiency of combustion—flue gas analysis, draft at various points and temperature within furnace or of the waste gases. Service men are quickly able to adjust regulators, dampers, etc., so as to minimize "excess air," maintain high CO_2, reduce stack losses and clear up leaky settings, broken baffles, cracks, etc. Detailed operating instructions are furnished.

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Previous issues of Instruments contained the following articles:

January:

The Use of the Microscope in Industry.

A Résumé of the Magnetic Methods Employed in Studying the Mechanical Properties of Matter.

Sand Tests—What Do They Mean?

Complete Gas Analysis by the Simultaneous Oxydation of Methane, Carbon Monoxide and Hydrogen.

A Portable Photometer for Measuring Colored Light.

February:

Instrument Pioneers—Alessandro Volta (1745-1827).

Comparison of the Various Methods of Testing the Hardness of Metals.

Measuring to Four Parts in a Billion.

Instruments for the Measurement of Electrical Insulation, Part I.

The New Improved Type of Brady B.T.U. Indicator.

The Measurement of Luster.

March:

Instrument Pioneers—Oliver Blackburn Shallenberger (1860-1898).

Humidity Test Equipment.

Instruments for the Measurement of Electrical Insulation, Part II.

Determination of Specific Gravity, Surface Moisture and Voids in the fine Aggregate for Use in Concrete Mixtures.

Electric Meter History.

The Stroborama

(*Musa-Hartzell-Ducasse, Inc.*)

MOST engineers and physicists are familiar with instruments called "Stroboscopes," which make moving mechanisms appear at a standstill; but until the advent of the "Stroborama," these instruments were very limited in their uses because they lacked power of illumination.

Other stroboscopes are using flashes of light through a Neon Tube; but their illumination and method of producing the light flashes do not approach the power and exactness of the Stroborama.

The Neon Lamp of the Stroborama produces an illumination of 1000 candle power; the light is well diffused, to prevent shadows and to flood mechanisms of very large dimensions such as an entire automobile engine or an entire motor car. It is so strong that observations can be made in full day light.

Current Control and Synchronization—To produce such a strong light the Stroborama must use a considerable amount of current and its oper-

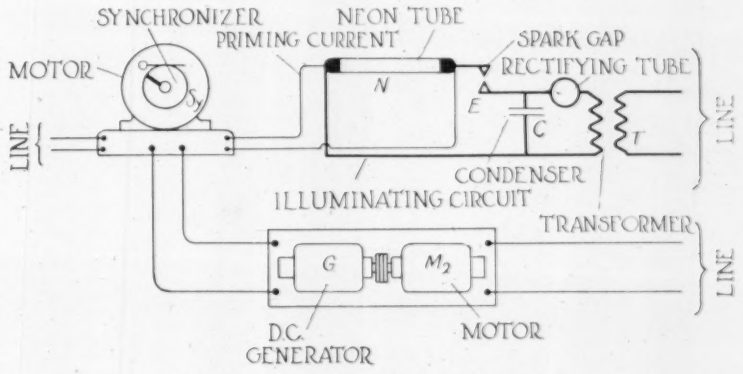


Fig. 1. Circuit Diagram of the Stroborama

ation requires 1500 watts of an alternating current of either 110 or 220 volts, 50 to 60 cycles, single phase.

Obviously, it is impossible to produce fast intermittences of such a heavy current through a mechanical contact-breaker.

In the Stroborama, a rotary contact-breaker (Fig. 1) Sy, constituting the synchronizer, produces intermittent discharges of a low capacity condenser, charged to a few hundred volts by a continuous current generator M2G, in the primary winding of a high frequency transformer, which raises the tension to produce a discharge of the current through

the Neon Tube, N. This discharge is the "priming Current" which controls the passage of the illuminating current.

The illuminating current is prepared in the high tension transformer T. Alternating current is raised to the high voltage (15000 volts) required for illuminating the Neon Tube; a rectifying tube changes the alternating current to direct in order to maintain constantly charged a powerful battery of condensers, C.

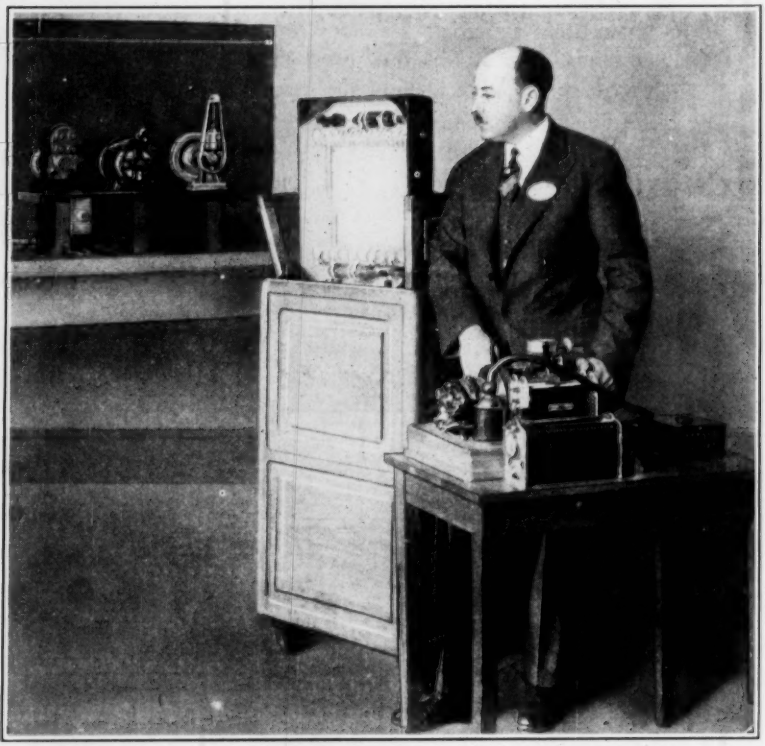


Fig. 2. The Stroborama, Type A, showing Cabinet with Neon Projector and the Independent Synchronizer.

To discharge through the Neon Tube, N the current must jump through a spark gap, E, adjusted so that the resistance of the gap, added to the resistance of the Neon Tube, does not permit the condenser to discharge.

When the priming current passes through the Neon Tube, it reduces the resistance of the system and the condenser discharges through the gap and through the tube, producing an intense light flash and one of such extremely short duration that parts of mechanism moving at a linear

speed or peripheral speed of 350 feet per second appear with sharp and distinct contours and without any distortion of form or size.

By this simple arrangement, the Stroborama can control fast interruptions of an illuminating current of extremely high power.

Independent Synchronization—An invaluable feature of the Stroborama is its independent synchronizer. This not only saves the lengthy and tedious labor of effecting connections with the mechanism to be observed, but it makes it possible to show the mechanism not merely standing still but also with a continuous forward or backward movement at any desired speed. This often uncovers parasitic effects otherwise impossible to detect. When an interesting portion of the motion is particularly desirable to study, it can be rocked back and forth: the experimenter may concentrate his observation on a specific amplitude of the motion, leaving his mind undisturbed by what may be taking place in other portions of the cycle.

Another value of this feature is that when different parts of a mechanism are moving at different speeds, they may be brought to rest successively at a moment's notice.

Uses of the Stroborama

With the Stroborama, the analytical ability of the research engineer or the physicist or the chemist are greatly enhanced, because they are enabled to look *inside of motion*, as well as the X-ray enables a surgeon to see the organs inside of living bodies.

The Stroborama is a practical research instrument. It can be set in operation in less than two minutes, since it does not require any physical contact with or drive from the mechanism under observation.

In contrast with the method of study by slow motion pictures, the Stroborama has the decided advantage of *direct visual observation*. Not only the mechanisms retain their true shapes, sizes, reliefs and depths, but the mechanisms can be observed from any position in the three dimensions and no parasitic effort can remain hidden.

The applications of the Stroborama are numberless, because it applies to the study of all fast periodic motions.

Automotive Industries—Study of valves, springs, cam design, crankshaft distortion, lubrication, vibrations, gears and timing chains, propeller shafts and universal joints, suspension springs and shock absorbers, deflection of tires, resiliency of rubber.

Hydraulics—Atomizers, injectors, spray nozzles of internal combustion or Diesel engines.

Study of nozzles and impellers in water turbines or Pelton wheels.

Naval Construction—Study of naval shapes in the Froude bassin, propellers.

Aerodynamics—Study of streamlines, wing shapes, propellers in the wind tunnel or on the plane itself.

General Mechanics—Vibrations, balancing of rotating parts, study of large rotors.

Machine Tools—Study of cutters, grinding wheels.

Rotary Printing Presses—Observation of the moving printed work, matching of color contours.

Diversified Uses—Sewing machines, flexible shafts, speed counters, gyroscopes, moving picture machines, ball and roller bearings, adjustment of clocks, study of sound waves in musical instruments and radio loud speakers.

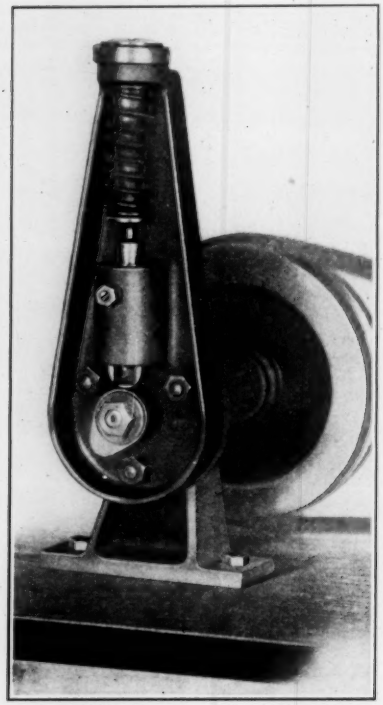


Fig. 3. View of a Valve, Spring and Lifter, operated by a Cam revolving counterclockwise at 1400 R.P.M.

(Note the excessive vibrations of the spring coils, although the valve is at rest on its seat.)

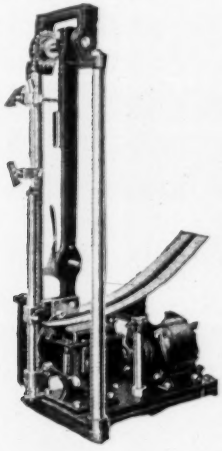
With the Stroborama, research work in motion can reach further. It is a practical instrument for practical work and its cost of operation is nothing more than the cost of current consumed at the rate of 1½ kilowatts for each hour of operation.

Improved Motor Driven Tensile Strength Tester

THIS tester, recently placed on the market and manufactured by the Amthor Testing Instrument Company, is constructed on the desk type. A one-sixth H.P. General Electric constant speed motor is mounted on its base and is connected directly to the speed reduction unit by a flexible coupling. This results in a compact, rugged instrument.

It can be set up at any convenient place and after the connecting wire, which is supplied with the tester, is plugged in the light socket, it is ready for use. All belt drives and installation are eliminated.

A feature of the instrument is the sealed mercury to mercury contact switch through which the current is fed. The motor is started and stopped by operating this switch and during the operation of the tester



when comparative readings for load and elasticity are desired, the test can be stopped instantly at any point. This switch also stops the motor automatically at the point of maximum travel.

This tester is built on the inclination balance type with the pendulum having a maximum angular swing of 45 degrees. The pendulum swings in a set of precision ball bearings practically eliminating all friction and in this way making the tester extremely sensitive.

The load is balanced by the inclination of the lever and is reflected directly to the quadrant scale. Springs and other mechanisms are entirely eliminated.

The pulling clamp is attached to the upper end of a guide tube which gets its uniform linear standard pulling speed through a chain and sprocket driven by a motor through the speed reduction unit.

This unit consists of a double set of worm gears running in heavy constructed annular ball bearings. These run in an oil bath and require no attention.

The operation of the tester is extremely simple and quick. After the motor is once started, it runs throughout all of the tests. The sample is inserted in the clamps, the lever in front of the reduction unit is pressed down, the pulling clamp starts downward and the pendulum swings out on the quadrant scale.

The instant the sample breaks, the downward motion is stopped, the pendulum is held in position by a set of lock pawls engaging in a rack and the readings are had. To repeat the test, the pendulum is quickly brought back to zero by releasing the lock pawls and the guide tube is pushed up to its starting position. Due to this quick handling, this tester is very efficient.

Standard test weights under normal working conditions of the tester are used to mark each individual line. In this way the readings extending over a distance of 18 inches, are absolutely accurate.

Another feature of the instrument is that the specimen and the readings are always in the same line of vision. In this way the action of the specimen under test can always be noted and elasticity readings under various loads can be had.

This instrument is made with the best materials and by the highest craftsmanship. In appearance it is pleasing to the eye. The castings are baked japanned with gold stripings. The other parts are brightly nickel plated.

This tester is especially adapted for thin metal sections, wire, paper and similar products.

It can be calibrated up to a maximum capacity of 500 pounds and if required elongation scales and recorders can be supplied.

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The Hammer-Fennel Tacheometer Model 1927

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THE demand for a comparatively small, light instrument for stadia measurements, with which one can determine quickly horizontal distances, elevations and horizontal angles without complicated calculations and tables, was met by the Hammer-Fennel Tacheometer, Model 1927.

This instrument is similar in its outer form to a solidly built repetition-theodolite without the vertical circle. It has a telescope of special construction, which cannot be reversed (see Fig. 1).

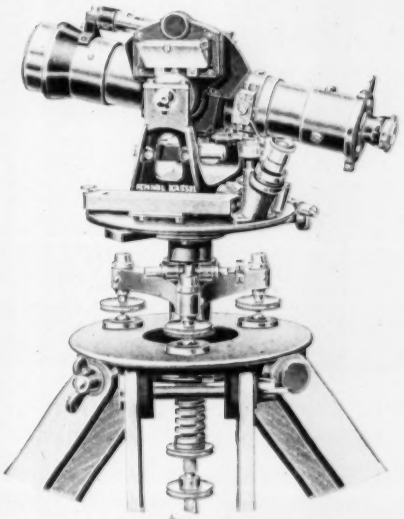


Fig. 1

In aiming it at the stadia pole, one sees in the telescope —in the left half of the field of view— a diagram, whose lines shift themselves in the horizontal direction with each vertical movement of the telescope. After setting the zero curve on the zero mark of the pole on which one sights, one reads off two values where the diagram lines cut the divisions of the pole. First the distance number, which is multiplied by 100 and second the elevation value, which is multiplied by 20 and gives the difference in elevation between the point at the foot of the stadia pole and the instrument station, without the necessity of a further calculation, diagram or table.

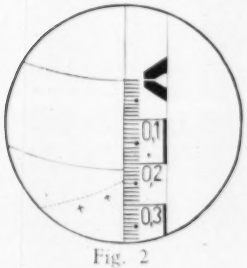


Fig. 2

Fig. 2 illustrates an example, with which the following results are obtained: 0.215 x 100 = 21.5 meters horizontal distance and + 0.241 x 20 = + 4.82 meters difference in elevation. The elevation curve shows the + signs, if the line of sight rise above the horizontal and the — sign, if below. The construction permits an inclination of ± 30°.

The horizontal angles are read on the small microscope, which is fastened beside

the ocular of the telescope, so that all the readings can be made without the observer changing his position. The divisions are made on solid silver, either in 1/6° in the sexagesimal system (360°) or in 1/10° in the centesimal system (400°). Each full degree is numbered and one can estimate the minutes with ease. See Fig. 3, reading 124° 35′.

The instrument is supplied with one level on the telescope and 2 levels on the vernier plate. A trough compass is attached on the side of the telescope bracket. The tripod with the metal head and the mahogany carrying case with leather strap are in keeping with the first class workmanship of the instrument.

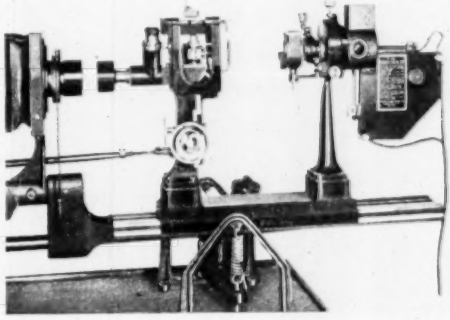
Fig. 3

In many cases the time required for a reading is one-half that required for making a reading with circle tacheometer. The accuracy obtained with this instrument lies within the limits required for topographical measurement.

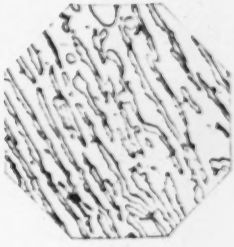
The Hammer-Fennel Tacheometer, Model 1927, has in comparison with the Model 1900, which was built until now, the big advantage, that its outer dimensions and therewith its weight has been considerably diminished. This reduction can best be seen from the fact that the case for the instrument has now only 50% of its former volume. Its dimensions are now 30x20x28 cm.

The telescope is furnished with an inner focussing lens and is totally water and dust proof. The focussing of objects at various distances being accomplished by the movement of a lens along the optical axis by means of an improved mechanical system.

This new instrument description is the same as that appearing in the February issue, except that the manufacturer sent the wrong cut for Fig. 2.



Left: Large Metallographic Equipment. Below: Cast Iron Specimen magnified 1500 times.



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Current Literature Review

Abstracts on instruments of interest to instrument readers

A Superheat Meter or Differential Thermometer for Airships. D. H. Strother and H. M. Eaton. T 359, T. P. B. of S.

This instrument consists of a thermopile having one set of junctions in the gas cells of an airship and the other set in free air. The facts that the temperature of both junctions may vary considerably, that the distance between junctions was 90 feet, and that the galvanometer had to combine high sensitivity with steadiness of reading when subjected to the surging of an airship in flight, all had an important influence on the design of the instrument.—L. E. B.

Daylighting in Multi-Storied Industrial Buildings. Andrew Vogel, A. J. Martin, W. C. Randell and Frank Benford. Trans. I.E.S. Feb. 1928, pp. 127-198.

Correctness in design of daylighting equipment being of great importance in industrial buildings, a study was made of illumination results obtained in a typical plant and in models of the same plant. The models used are completely described and graphs of results obtained by the two methods agree remarkably and demonstrate the reliability of model tests.—L. E. B.

A Simple Method of Finding the Sound Absorbing Power of Building Material. Gunnar Heimburger. Phys. Rev. Feb. 1928, pp. 275-282.

This paper describes an accurate method of comparing the absorbing powers of building materials. Values are given for the absorption coefficients of various building materials for a sound whose frequency was 295.—S. R. W.

Does Hardness Govern? E. Bremer. Foundry. Feb. 1, 1928, pp. 106-108.

Paper points out that correlating of Brinell hardness with other hardness qualities is complicated; it is believed that definite steps should be taken to investigate various relationships and establish Brinell hardness test as indicator of certain qualities on standard basis; need for this is exemplified in number of replies received in answer to letters requesting information on value of Brinell test.—A. A. G.

Testing of Materials. F. L. Atkin. Gas World. Feb. 4, 1928, pp. 103-104. Paper read before Midland Junior Gas Association.

Knowledge of exact strength of materials of structure, plant, or pipe systems, gives that security and confidence which is necessary to every gas engineer; specifications; tensile test; hardness tests; bending and forging tests.—M. B. R.

Determination of Resistance of Refractories to Changes of Temperature. (Beitrag zur Bestimmung der Temperaturwechselempfendlichkeit feuerfeste Baustoffe.) W. Miehr, J. Kratzert and H. Immke. Tonindustue-Zeitung. Jan. 11, 1928, pp. 56-60 and Jan. 14, 1928, pp. 77-78.

Report of Didier Laboratory and Research Institute. Critical discussion of American water quenching spalling test, pointing out its misleading character and disagreement with practical experience. German modification of American spalling test. New German test, quenching being done by compressed air and water spray. Modification of tests for refractories of high silicon content.

Describes Sand Test Methods. (Translation of paper by Dr. A. Kessner, Technical University, Karlshuhe, Germany.) The Foundry. Feb. 15, 1928, pp. 144.

Methods for testing the properties of sand which has been rammed up into molds are described. Surface hardness is measured by the dimensions of the impression made by pressing a cone or ball into the sand with a standard load or by dropping a ball from a standard height. Specimens for permeability and green bond tests are cut from the mold with a thin sharp tube. Permeability is measured by the time required to draw 200 cc. of air through the specimen. Bonding strength is measured by the length of specimen that can be pushed horizontally from the tube before it breaks.—A. A. G.

Testing and Care of Venturi Meters. II, Fred Emmar. Power Pl. Engg. April 1, 1928.

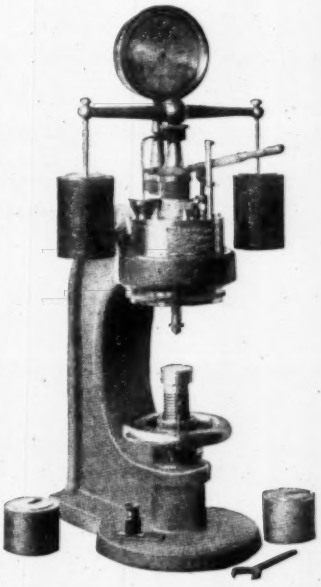
General notes on some of the factors affecting operation of Venturi meters. Use of the special Venturi Planimeter.

Field Balancing Rotors at Operating Speeds. G. B. Karelitz. Power. Feb. 14, 1928, pp. 286-289.

First article published in Feb. 7th issue. In this concluding article is described a mechanical method for determining the location and size of correction weights necessary for eliminating rotor vibrations.

Electrical Units and Measurement—the Ampere. H. M. Phillips. So. Power J. April 1928, pp. 48-51.

Amperage the rate of flow. The basic unit of current. Alternating current measurement. D.C. modification.



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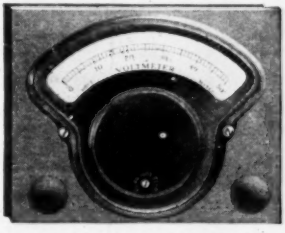

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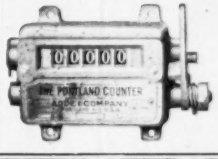

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The Power Plant Log is Valuable to Every Operating Engineer. L. A. Cole. So. Power Jl. April 1928, pp. 52-54.

Forms for making out reports are given.

Tests in Locating Faults of Treatment. II, John D. Gat. Heat Treating & Forging. March 1928, pp. 274-276.

Temperatures in quenching. Non-uniform immersion. Steel not suitable for hardening and the application of carburization to tests. Necessity for checking pyrometers.—D. L. M.

Tests in Machining Manganese Steel. A. S. Martin. Heat Treating & Forging, pp. 282 and 296.

A high speed tool steel has been found effective in machining a material hitherto practically unmachinable. Methods and results described.—D. L. M.

Convenient Movable X-Ray Equipment. A. St. John. Heat Treating & Forging, pp. 292.

Castings, welds and metals may be examined where located. Lead enclosed tube is used making lead-lined room unnecessary.—D. L. M.

Testing of Steels by Corrosion. (L'essai de corrosion des aciers.) Genie Civil. Jan. 28, 1928, pp. 90-92.

Corrosion tests useful for observing manner in which forging or welding has been executed; micro-photography of parts broken in service reveals flaws. Paper shows how micro-photography is used in connection with corrosion tests to bring out presence of impurities in metal.—O. W. E.

The Test-Plate. Walter Mindt. Optician & Scientific Instrument Maker. March 9, 1928, pp. 41-44, March 16, 1928, pp. 59-62.

A Method of Testing Optical Surfaces depending on the Interference Phenomena of Light.—R.R.

Balancing Rotary Parts by a New Method. C. O. Herb. , Machinery. Feb. 1928, pp. 466-469.

Description of Olsen-Lundgren process in which amounts and angular locations of unbalance in part are determined without rotating work at critical speed. Crankshafts of all passenger cars balanced statically and dynamically before assembled into engines. Advantages derived from balancing. Determining static and dynamic unbalance. Machine construction. Procedure in balancing part. Measures pressure of centrifugal force caused at each bearing support by unbalance in piece being tested.

The Wear of Cast Iron. Bull. No. 19. Brit. C. I. Res. Ass. Jan. 1928, pp. 9-13.

Review of recent experimental work covering automobile pistons and cylinders, brake blocks, locomotive valve rings and work hardening.—A. L. N.

Methods of Testing Calcium Carbide. Foundry Trade Jl. March 8, 1928, pp. 163-164.

Importance of quality standard. Standardized methods. Gravimetric method preferred. Conversion data. Volumetric testing. Speed of determination favors volumetric testing. Apparatus for large scale testing.—C. W. K.

Wind-Pressure Tests Made on Large Model Building. E. R. Dawley. Engg. News Rec. March 29, 1928, pp. 508-510.

Results indicate older formulas are too high. Framework may offer greater resistance than covered building. Effect of open windows.—J. H.

Late Developments in Electric Method of Locating Depth of Water Intrusion in Oil Wells. J. H. Tinkham. Oil Age. March 1928, pp. 27-28.

The method described in this article is based upon the principle of measurement of the electrical potential difference between two dissimilar metals while being moved through an electrolyte varying in concentration and in chemical characteristics. Equipment used. Water entry point recorded.

The Measurement of Choke Coil Inductance. C. A. Wright and F. T. Bowditch. Proc. Inst. Radio Engrs. March 1928, pp. 373-384.

The investigation described in this paper has emphasized the facts that:

1) The inductance of the choke coil depends upon the degree to which its core is magnetically saturated because of the direct current flowing through its winding.

2) With a given direct current flowing through its winding, the inductance varies to a marked extent with the magnitude of the alternating current flowing through the winding. Methods of measurement which do not take into account or measure the magnitude of the alternating current are, therefore, unreliable.

3) The inductance for given conditions may be determined from the saturation curve of the coil.

Three modifications of the ammeter-voltmeter method of measuring inductance are presented. —Ha.

New Methods in Photomicrography. Francis F. Lucas. Heat Treating & Forging. March 1928, pp. 277-281.

Paper presented at joint meeting of American Society of Mechanical Engineers and Optical Society of America. Description of apparatus in the Bell Telephone Laboratories. The Ultraviolet microscope. High power metallography in the study of structures in hardened steel.—D. L. M.

Methods for Determining Moisture in Aggregates. Concrete Highways & Public Improvements. March 1928, pp. 50.

Methods for determining moisture in aggregates are given.

Characteristics of Greases and Methods of Testing. Lubrication. Feb. 1928, pp. 17-18.

Hardness. Method of testing grease for hardness. Melting point. Consistency. Color. Odor.

LEITZ New Universal Binocular Stereo Microscope "UBM"

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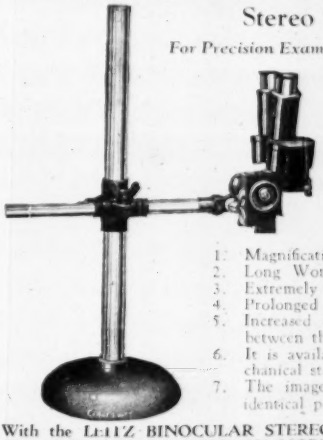

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The Calculograph. H. C. Dilsizian. Electrical Communication. Jan. 1928, pp. 158-160.

The calculograph is an instrument which was developed to provide an accurate means of computing the duration of long distance calls. Its operation is described.

Accuracy in Large Machine Tools. T. K. Smyth and W. C. Wais. Amer. Mach. March 29, 1928, pp. 527-530.

Constant temperature maintained in room where standard gages are kept. A long measuring Machine. Aligning large machine tools. All cylindrical work finished by grinding.—H. S.

Improving Engine Performance. H. M. Jacklin. Jl. S. A. E. March 1928, pp. 337-344.

Results of three sets of investigations looking to the improvement of internal-combustion engine performance are set forth. The first set was with multiple ignition, the second with high compression, and the third with the comparative behavior of a variable-compression engine when operating as a constant-clearance engine and when operating with constant compression.

Continuation of the 1922 Report on Brake Lining Tests. Jl. S. A. E. March 1928, pp. 365-376.

Discussion of S. von Ammon's paper published in the Nov. 1927 issue of Jl. S. A. E.

Recent Applications of X-Rays. V. E. Pullin. Jl. Scient. Instr. Feb. 1928, pp. 41-47.

Outline of the work of the Radiological Research Laboratory at Woolwich, England.—M. B. R.

Stevenson Creek Arch Dam Experiments. F. A. Noetzli. Can. Eng. March 27, 1928, pp. 395-397.

First series of tests on experimental arch dam undertaken for scientific purposes by Committee appointed by Engineering Foundation of New York. Much valuable information obtained from tests. Withstands flood strain.—J. H.

An Electrical Sounding Device for Boreholes. A Gradenwitz. Engg. Min. Jl. March 1928, pp. 541.

Presence of salt water may also be determined. Likewise temperatures.

An Improved Fast Method for the Determination of Gases in Metals, Especially Oxygen in Steel. (Ein verbessertes Schnellverfahren zur Bestimmung der Gase in Metallen, insbesondere des Sauerstoffs im Stahl.) W. Hessenbruch und P. Oberhoffer. Ber. 54 Chemikerausschusses. March 1928, pp. 583-603.

Development of the hot extraction method. Investigations on the procedure in the hot extraction process. Improvements in the apparatus in the last two years. Development of a new method. Control of the apparatus. Reduction of the pure oxide. Influence of the sample surface and the temperature on the gas determination. Comparison of the different hot extraction methods.

The Fundamental Principles and the Field of Use of Distance Measurements. (Grundzuege und Anwendungsgebiete der Fernmessungen.) Karl Gross. St. u E. March 8, 1928, pp. 297-306.

The types of distance measurements. Mechanical transmission. Electrical transmission. Indicating instruments. Switching. Distant transmission and current sources. Electrical transmission with special apparatus. Thermo-currents. Resistance measurement. Electrical transmission with tester. Centralized measuring stations.

The Workability of Steels Used in Automobile Construction. (Die Bearbeitbarkeit der Konstrukbonsstaehle im Automobilbau.) G. Schlesinger. St. u E. March 8, 1928, pp. 307-312, March 15, 1928, pp. 338-345.

Determination of efficient cutting speeds and feeds for the working of caschardening and heat treating standard steels. Comparison investigation to include open-hearth steels. Influence of water cooling.

A New Technical Color Measuring Apparatus. (Ein neuer technischer Farbmessapparat.) Freda Herzfeld-Hoffman. Zs. Instrument. March 1928, pp. 105-108.

A new instrument based on the Koenig-Martens Method was developed by Schmidt & Haensch, is described.

Accuracy Investigations on a Geodetic Double Image Distance Measuring Instrument. (Genauigkeitsuntersuchungen an einem geodaetischen Doppelbild-Entfernungsmesser.) Karl Luedemann. Zs. Instrument. March 1928, pp. 109-113.

Measurement to determine the accuracy as carried out. Bibliography also given.

The New Wild Precision-Theodolit. (Der neue Praezisions-Theodolit Wild.) P. Werkmeister. Zs. Instrument. March 1928, pp. 114-116.

A new Theodolit built by H. Wild of Heerbrugg, Switzerland, is described and illustrated.

Information on the Development of Extensometers for Short Lengths. (Beitrag zur Entwicklung von Dehnungsmessern kleiner Messlaenge.) Kurt Boettcher. Zs. Instrument. March 1928, pp. 116-125.

Review of the known extensometers for short lengths. Demands placed on extensometers. Physical or optical indication.

Catalogue Library

Check any of the publications you want. Remove the page and send with coupon to INSTRUMENTS. They will be forwarded to you without cost or obligation.

UNDOUBTEDLY the catalogues of a decade or so ago lived up to the strict dictionary definition "a list of things." Today, however, a catalogue is the result of no small effort and expense on the part of the manufacturer, who sets forth the merits of his product in such a manner that the public is made to recognize all its good points. Details of manufacture and operation of the instrument are given in considerable detail. It is a learned mind, indeed, that cannot derive some information from this type of literature. As a matter of fact, few books can be purchased where the information contained therein is more up-to-date than that found in the average catalogue.

In this section will be listed each month the new catalogues published during that time by the various instrument companies, who place such information at the disposal of the editor. Only such catalogues or bulletins should be requested as will be of direct interest to the individual making the request. When the catalogue or bulletin is received it should be carefully filed or afforded the protective accommodation of a book shelf. It will then be available for ready reference at all times and avoid a request for duplicate copies.

Acid Bath Controls

Circular 39-G-5-128 of the Leeds and Northrup Company, 4901 Stenton Ave., Philadelphia, Pa., illustrates their Automatic Control for Mercerizing baths.

Automatic Steam Operated Control

C. J. Tagliabue Mfg. Co., 18 Thirty-third St., Brooklyn, N. Y., have just issued a leaflet announcing a new system of automatic control. A large drawing shows the controller almost full size.

Aircraft Recorder

A recent leaflet of R. W. Cramer & Co., 136 Liberty St., New York, N. Y., briefly points out the importance of keeping permanent records of aircraft operation by means of the Hasler Recorder. The operation of the instrument is the subject of another leaflet.

Automatic Blast Furnace Temperature Controls

Leeds and Northrup Company, 4901 Stenton Ave., Philadelphia, Pa., illustrate the use of their control for blast furnace temperatures in Circular F-30-P-10-727.

Automatic Temperature Control

The Brown Instrument Company, Wayne & Roberts Aves., Philadelphia, Pa., has just issued the second edition of their Catalog No. 87, entitled "Brown Automatic Temperature Control Instruments."

B.T.U. Indicator

The Brady-B.T.U. Indicator is described in bulletins issued by the Physical Laboratory of the United Gas Improvement Co., 3101 Passyunk Ave., Philadelphia, Pa.

Baro-Vacuummeter

The application of the Baro-Vacuummeter is described in a recent leaflet No. Wa-No. 134 of Bopp & Reuther, G.m.b.H. Mannheim-Waldhof, Germany. This is printed in German.

Beating Tester

"A Tester that Interests You" is the title of booklet 190 issued by the Foreign Paper Mills, Inc., 72 Duane St., New York, N. Y. It describes an apparatus for testing the fineness of paper fibres.

Bench Lathes

Precision Bench Lathes are taken up in a recent direct mailing of the Stark Tool Company, Waltham, Mass.

Bending Tester for Boards

Booklet No. 307 issued by the Foreign Paper Mills, Inc., 72 Duane St., New York, N. Y., very completely discusses a new instrument for testing the bending strength and bending angle of paper boards.

Brake Testing Meter

The Tapley Performance Meter for Brake Testing as the title of a recent bulletin of E. C. Chessell, Melrose Highlands, 77, Mass.

Calipers

The Indicating Calipers Company, 506 East 19 St., New York, N. Y., have issued a leaflet describing their indicating calipers which incorporate the features of outside calipers, scale, magnifier and indicator.

Calculating Machines

A recent Leaflet issued by Ludwig Stotz & Co., Berlin-Tempelhof, Ercshotzstr. 22-25, Germany, illustrates some of the calculating machines made by this company.

Chromalox Bulletin

The March issue of this bulletin issued by E. L. Wiegand Co., 422 First Ave., Pittsburgh, Pa., shows the various applications of their product to electrical heating in industry.

Calculator

The Otis King Calculator is described in a recent bulletin issued by The A. S. Aloe Co., 1819 Olive St., St. Louis, Mo.

Calorimeter

Bulletin Eight, issued by Lewis M. Ellison, 214 West Kinzie St., Chicago, Ill., describes the U-path Steam Calorimeter manufactured by this company.

Coal Meter

"C. J." Coal Meter is the title of a bulletin issued by The C. J. Mfg. Co., 3425 N. 5 St., Philadelphia, Pa.

Dial Indicators

Federal Precision Dial Indicators are illustrated in a recent leaflet sent out by the Federal Products Corp., Providence, R. I.

Draft Gauges

Bulletin Nine of Lewis M. Ellison, 214 West Kinzie St., Chicago, Ill., describes and illustrates the various types of draft gauges manufactured by this company.

Electric Measuring Instruments

Bulletin No. 24D of the Pignolet Instrument Company, 76 Greenwich St., New York, N.

Y., describes the instruments manufactured by this company for direct current: Millivoltmeters, Voltmeters, Milliammeters, Ammeters and Ohmmeters.

Electrometric Titration Apparatus

A recent leaflet of Arthur H. Thomas Company, West Washington Square, Philadelphia, Pa., takes up the Kelley Electrometric Titration Apparatus.

Experimenter

The March issue of the Experimenter, issued by The General Radio Co., Cambridge, Mass., contains the following articles: Factors Concerning the Use of the Type UX 250 Power Amplifier Tube; and New General Radio Apparatus.

Firth Hardometer

Bulletin No. 2 of Thos. Firth & Sons, Ltd., 8 The Sanctuary, Westminster, S.W. 1, London, England, shows a new kind of hardness testing machine.

Gas Service Journal

The February Gas Service Journal published by the Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa., contains the following articles: Gas as a Domestic Cooking Fuel; Growth of Gas Heating; Carbon Monoxide and Bad Ventilation; A Growing Industry; Gas Companies Face Prosperous 1928, and Technically Speaking.

Gradient and Performance Meter

E. C. Cheswell, Melrose Highlands, 77, Mass., has issued a leaflet on the above instrument, which gives the driver of a car definite knowledge of the conditions under which he is driving.

Hydrogen Ion Outfit

Sup. 88-22 M-3 '27 issued by Arthur H. Thomas Co., West Washington Sq., Philadelphia, Pa., illustrates the Bovie Hydrogen Ion Outfit.

Micromanometer

A new micromanometer designed by G. Newmann in a leaflet issued by Robert Mueller, Kommandit-Gesellschaft, Essen, Germany. This leaflet is printed in German and discusses the special advantages of this instrument.

Microscopes

The new large Stand F Microscopes are illustrated and described in Bulletin Mikro 418, issued by Carl Zeiss, Inc., 485 Fifth Ave., New York, N. Y.

Microscopes

Spencer Binocular Dissecting Microscopes are illustrated and described in Bulletin M-19 of the Spencer Lens Co., 19 Doat St., Buffalo, N. Y.

Paper Testers

Schopper Standard Paper Testers are illustrated in a leaflet issued by the Foreign Paper Mills, Inc., 72 Duane St., New York, N. Y. The various instruments used for testing paper are shown.

Paper Testing Machinery

Catalogue 257 of the Foreign Paper Mills, Inc., 72 Duane St., New York, N. Y., describes in detail the various paper testing machinery sold by them.

Pyro Pyrometers

A recent leaflet of the Pyrometer Instrument Co., 74 Reade St., New York, N. Y., gives a few of the testimonials received from purchasers of Pyro Radiation Pyrometers.

Motor Vehicle Recorder

A recent leaflet of R. W. Cramer & Co., 136 Liberty St., New York, N. Y., briefly points out the importance of controlling motor vehicle operation by means of the Hasler Tel Recorder. The operation of the instrument is the subject of another leaflet.

Regulator

A recent direct mailing of the Minneapolis-Honeywell Regulator Co., Wabash, Ind., shows the first of a new series of advertisements issued by this company.

Rubber Testing Machinery

Catalogue No. 301 of H. Z. Schniewind, 72 Duane St., New York, N. Y., illustrates and describes the various rubber testing machines sold by this company.

Surveying Instruments

Catalogue No. 124 of Otto Fennel Sons, Kassel 85, Germany, illustrates the levels and transits manufactured by them. The

Universal Measuring Microscope

"The Carl Zeiss Universal Measuring Microscope" is the title of a recent bulletin of George Scherr Co., 142 Liberty St., New York, N. Y. This bulletin takes up the two distinct fields of application of this instrument: 1.—the measuring of all dimensions of a screw thread including the correct pitch diameter; 2.—the checking, laying out or spotting of all kinds of jigs, templets, forming tools, etc. The subjects covered are: Measuring of screw threads; Knife edge method; Elimination of all screws; General construction; Laying out and measuring by co-ordinates; Dividing center; Equipments available.

catalogue is printed in English.

Voltmeters

The Weston Headlight Inspectors Voltmeter is shown in a leaflet issued by the Weston Electrical Instrument Corp., Waverly Park, Newark, N. J.

Water Meters

American and Niagara Water Meters, built by the Buffalo Meter Co., 2917 Main St., Buffalo, N. Y., are shown in a recent leaflet of this company.

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Information Section

Correspondence from instrument users and others pertaining to or relative to instruments

THIS section invites correspondence from instrument users and others relative to questions pertaining to instruments. If our own editorial staff should feel that any question submitted cannot be readily answered, we will obtain the necessary information from some of our collaborators. Thus the greatest experts are at the disposal of our readers in assisting them in the solution of their instrument problems.

Names and addresses of manufacturers of instruments will be furnished on special request. Inquiries pertaining to sources of supply should be addressed in writing to our Information Section. Such inquiries will be answered promptly by mail.

Inquiries regarding instrument problems will be answered by publication in this special "Information Section" of INSTRUMENTS. We feel that other besides the inquirers may be interested in the same or similar problems, and in this way all of our readers will obtain the benefit of the information furnished.

No. 1. We are at the present time looking for an instrument for detecting noises in ball bearings. We are wondering if you have any information in your files about concerns which make instruments, which could be used on a production basis, for detecting noises in bearings?—V. W. F.

No. 2. Can you put us into communication with the manufacturers of the Howard-Dolman Depth Measurement Instrument?—E. F. H.

No. 9. Kindly furnish me with reference for an electrical instrument for detecting water leaks.—L. L. T.

No. 13. We would be pleased to have you notify us where we can obtain jewels for indicating meters, F.

No. 14. Who is a maker of an indicating or recording instrument for chlorine gas mixture with N_2, O_2 and possibly some H_2O? The chlorine content varies from 0—50%.—T. C. W.

No. 15. We are looking for a device to indicate and possibly record low pressure differences. The values range from zero to 25 millimeters of water and we desire to read the pressures to one tenth millimeter fairly accurately.—A. A. G.

No. 16. Could you send us the names of dealers who handle apparatus for measuring linear expansion, particularly the linear expansion of thin metal foils?—D. H. H.

Readers' Comments

This morning I had a visit from Mr. C. S. Hoyt, of Grove City College. I showed him INSTRUMENTS, but found that he already knew of it, and I know that you will be interested in what he told me about your recent article on sand tests. He says it is the best thing of the kind he has seen, and it was instrumental in helping some of his clients with a very difficult problem.

Sincerely yours,

E. H. McCLELLAND, *Technology Librarian.*

Comments on **Instruments for the Measurement of Electrical Insulation**

(This article appeared in February and March issues.)

Our reply to your letter of February 20th requesting comments on Mr. Watson's paper entitled "Instruments for the Measurement of Electrical Insulation" has been delayed. However, we are pleased to submit them at this time and trust they will not be received too late to be of benefit.

We have marked reference letters in the margin of the copy, which we are returning herewith. Our comments are as follows:

Paragraph 3, Page 141: High resistance voltmeter method is not listed, although this particular method is mentioned later on and the formulæ given by means of which resistance can be calculated.

High resistance galvanometer method is sometimes referred to as Direct Deflection Method—Using High Sensitivity Galvanometer. This is essentially a laboratory method and requires expert manipulation.

Paragraph 4, Page 141: It appears to us that cable factories are rather apt to use the direct deflection method—using high sensitivity galvanometer. They have proper facilities available and insulation resistances on short lengths of cables may be as high as several thousand megohms.

Paragraph 2, Page 142: Direct reading ohmmeters for the measurement of insulation resistance are now made with ranges up to 10,000 megohms.

An additional advantage of the ohmmeter type of instrument is, that its indications are independent of ordinary variations in the test voltage applied.

Paragraph 1, Page 144: We have heard engineers say the same thing and yet we believe it is conclusively proven that insulation resistance tests give worthwhile information even if the test voltage is far below the voltage at which the apparatus operates.

Paragraph 3, Page 144: If information regarding insulation resistance is to be properly interpreted, we believe there is no question that it must be done by obtaining results of periodic tests.

Paragraph 7, Page 144: Insulation resistance may vary slightly with test voltage. However, we do not believe it is necessary to use a test voltage as high or higher than the voltage at which the apparatus is designed to operate. 110 and 220 volt apparatus is commonly tested with "Megger" instruments operating at 500 volts. However, in common practice only 500 or 1000 volts are applied to machines operating at 660 or 13,200 volts.

There seems a rather general concensus of opinion that high voltage test should not be applied to apparatus in service, even though the test voltage may be only two or three times the operating voltage.

Paragraph 8, Page 144: We believe it is quite generally agreed that a high voltage test may damage insulation, although its application may not be of sufficient length of time to cause a break-down. If a high voltage test is to be applied, it should certainly be preceded by an insulation resistance test to ascertain if the insulation is of such resistance as to appear likely to withstand the high voltage test.

An insulation resistance test should also be made after the high voltage is applied to determine if the insulation has been weakened at any point. This is like "locking the stable door after the horse is stolen," so that while high voltage tests should unquestionably be made on new apparatus, we doubt whether such tests are advisable on apparatus which has been in service for some time.

Paragraphs 3, 4, 5, Page 145: We fully agree that these paragraphs sum up the entire matter very adequately.

Very truly yours,

JAMES G. BIDDLE

Comments on **Why Not Build Aircraft Instruments**

(This article is in this issue.)

I wish to thank you for your letter of March 12th, enclosing a copy of the article by Mr. Bradley Jones, which is to appear in the April issue of your magazine.

While the need for aircraft instruments is admirably expressed in this article, Mr. Jones gives quite an erroneous impression of the size of this field, and leaves the reader with the thought that there are now very few manufacturers of aircraft instruments.

The facts do not bear out Mr. Jones' position. He makes specific reference to nine different instruments. I believe you will be interested to know the manufacturing situation in regard to each of these. Referring to them in the order in which they appear in Mr. Jones' article, Oil Pressure Gauges for aircraft are now being manufactured and sold by five different companies. Several other companies manufacture these gauges, but are not actively selling the aircraft market now, as it is already overcrowded.

Compass. Three companies are manufacturing new airplane compasses, and one is rebuilding war surplus compasses for commercial use.

Air Speed Indicators are being manufactured by three instrument makers.

Tachometers are made and sold by five companies, all of which are very active.

Thermometers are manufactured by five active organizations.

Altimeters are made and sold by three different companies.

The Turn Indicator is manufactured only by this company, but as it is covered by basic patents (Sperry), under which we hold an exclusive license, it can not be manufactured by others than ourselves.

Inclinometers are manufactured by six different companies.

The Induction Compass is proprietary with this company and can not be manufactured by others without infringing our patents.

Referring to the instruments which are not mentioned by Mr. Jones, clocks for airplane use are manufactured and sold by many different companies.

Fuel Pressure Gauges are manufactured and sold by the same companies which make Oil Pressure Gauges.

Climb Indicators, Air Distance Recorders, and Speed and Drift Meters are all proprietary with this company, each of these instruments being made on an exclusive license basis under Sperry patents.

As indicated by Mr. Jones, the total airplane production in this country for last year was about 2500. With the exception of the Turn Indicator and Induction Compass, all the instruments mentioned by Mr. Jones are now manufactured by from four to six companies, giving an average of about 500 instruments as an annual production per company—hardly an inviting situation for instrument manufacturing companies whose plants are equipped for the production of several thousand units per day.

As Mr. Jones is interested in the procurement of instruments, his desire to have still more manufacturers in this limited field is understandable. It is hardly fair to your readers, however, to give them the erroneous impression which will inevitably be created by his article.

Very truly yours,

CHARLES H. COLVIN, *General Manager*,
Pioneer Instrument Company.

Review of Recent Patents

Printed copies may be obtained at the cost of 10 cents by addressing the Commissioner of Patents, Washington, D. C.

CALCULATING INSTRUMENT. Joseph Eugene Rowe, Williamsburg, Va. Pat. No. 1,661,095.

MATHEMATICAL INSTRUMENT. Joseph Eugene Rowe, Williamsburg, Va. Pat. No. 1,661,096.

THERMOSTATIC REGULATING DEVICE FOR HEAT PRODUCING APPARATUS. Axel Oswald Appelberg, Stockholm, Sweden, assignor to Aktiebolaget Birka Regulator. Pat. No. 1,661,103.

TIMING DEVICE. Gerald Deakin, Antwerp, Belgium, assignor by mesne assignment to Western Electric Company. Pat. No. 1,661,249.

AUTOMATIC WEIGHING APPARATUS. Rudolf Joksch, Vienna, Austria. Pat. No. 1,661,291.

METHOD AND APPARATUS FOR SETTING THERMOSTATS. David N. Crosthwait, Jr., Marshalltown, Iowa, assignor to C. A. Dunham Co. Pat. No. 1,661,323.

THERMOSTATIC CONTROLLING MECHANISM. Chas Baldwin Sawyer, Cleveland, Ohio, assignor to The Brush Laboratories Co. Pat. No. 1,661,346.

THERMOSTATIC CONTROLLING MECHANISM. Chas Baldwin Sawyer, Cleveland, Ohio, assignor to The Brush Laboratories Co. Pat. No. 1,661,347.

THERMOSTATIC CONTROL DEVICE. Fred W. Grundman, Cleveland, Ohio, assignor to The Brush Laboratories Co. Pat. No. 1,661,348.

THERMOSTATIC CONTROLLING DEVICE. Chas. B. Sawyer, Cleveland, Ohio, assignor to The Brush Laboratories. Pat. No. 1,661,349.

PAPER-TESTING MACHINE. Casper R. Taylor, Washington, D. C., assignor to Foreign Paper Mills, Inc. Pat. No. 1,661,549.

SCALE. James W. Bryce, Binghamton, N. Y., assignor by mesne assignment to Dayton Scale Company. Pat. No. 1,661,555.

DISTANCE RESPONSIVE CONTROLLER. Thomas H. Phillips, Jr., Brooklyn, N. Y., assignor to The Sperry Gyroscope Co. Pat. No. 1,661,677.

HARDNESS TESTING DEVICE. Donald C. Davis, Williamsville, N. Y. Pat. No. 1,661,718.

GAUGE FOR LIQUIDS. Kirk Brown, Montclair, N. J. Pat. No. 1,661,995.

GAUGING DEVICE. Reinhold Krumm, Philadelphia, Pa. Pat. No. 1,662,066.

ELECTRIC REGULATOR. Hugh M. Stoller, Mountain Lake, N. J. and Edmund R. Morton, New York, N. Y., assignors to Western Electric Company. Pat. No. 1,662,083.

ELECTRIC REGULATOR. Hugh M. Stoller, Mountain Lake, N. J., and Edmund R. Morton, New York, N. Y., assignors to Western Electric Company. Pat. No. 1,662,084.

WEIR DIFFERENTIAL GAUGE. Clarence C. Jacob, Myton, Utah. Pat. No. 1,662,248.

ELECTRIC REGULATOR. Edmund R. Morton, New York, N. Y., assignor to Western Electric Co. Pat. No. 1,662,252.

AUTOMATIC AND REMOTE HUMIDITY CONTROL. Frederick W. Rubin and Harry E. Rubin, Indianapolis, Ind. Pat. No. 1,662,283.

OPTICAL INSTRUMENT. John Charles Sabel, Rochester, N. Y., assignor to Bausch & Lomb Optical Co. Pat. No. 1,662,339.

VIBRATION INDICATING MEANS. John P. Ball, Chicago, Ill. Pat. No. 1,662,356.

MEASURING MACHINE. Albert Kingsbury, Greenwich, Conn., assignor to Kingsbury Machine Works. Pat. No. 1,662,425.

ELECTRIC SPEEDOMETER. Howard I. Murray, New York, N. Y. Pat. No. 1,662,433.

AUTOMATIC VOLTAGE REGULATOR. Frederick A. Tegeler, St. Joseph, Mo. Pat. No. 1,662,444.

INDICATOR. Newell Chandler McConahy, Tyrone, Pa. Pat. No. 1,662,463.

MEANS FOR TESTING FILTERS. Charles W. McKinley, Flint, Mich., assignor to A. C. Spark Plug Co. Pat. No. 1,662,529.

THERMOSTATIC CONTROL DEVICE. James C. Woodson, East Pittsburgh, Pa., assignor to Westinghouse Electr and Manufacturing Co. Pat. No. 1,662,556.

ELECTRICAL MEASURING INSTRUMENT. Argyle R. Rutter, East Pittsburgh, Pa., assignor to Westinghouse Electric & Mfg. Co. Pat. No. 1,662,835.

LIQUID LEVEL INDICATOR. George J. Daubaugh, Jr., Chicago, Ill., assignor to Champion Mfg. Co. Pat. No. 1,663,041.

MEASURING INSTRUMENT. Calvin F. Christopher, Canton, N. C. Pat. No. 1,663,440.

AIR GAUGE. Adelbert E. Bronson, Cleveland, Ohio, assignor to The Dill Manufacturing Co. Pat. No. 1,663,540.

THERMOSTAT. Georges Gaston Royer, Paris, France. Pat. No. 1,663,566.

ELECTRICALLY-CONTROLLED MEASURING DEVICE. Georges Gourdon, Malakoff, France. Pat. No. 1,663,590.

MEASURING APPARATUS. Oscar V. Holmquist, St. James, Minn. Pat. No. 1,663,598.

INDICATING DEVICE FOR INTERNAL-COMBUSTION ENGINES. Stephen Jencick, Chagrin Falls, Ohio. Pat. No. 1,663,600.

ELECTRICAL MEASURING INSTRUMENT. John H. Miller, Oak Park, Ill., assignor to Jewell-Electrical Instrument Co. Pat. No. 1,663,768.

CHART-RECORDING METER. Franz Maurer, Zug, Canton of Zug, Switzerland, assignor to the Firm Landis & Gyr. Pat. No. 1,663,807.

THERMOSTATIC CONTROL FOR GENERATORS. Clarence Ringwald, Chicago, Ill., assignor of one half to Chas. H. Caine, Chicago, Ill. Pat. No. 1,664,089.

THERMOSTATIC SWITCH. Carl J. Fay, Mansfield, Ohio, assignor to Westinghouse Electric & Mfg. Co. Pat. No. 1,664,201.

MAXIMUM-DEMAND METER. Lewis Warrington Chubb, Edgewood Park, Pa., assignor to Westinghouse Electric & Mfg. Co. Pat. No. 1,664,243.

MOTOR REGULATOR. Paul F. Shivers, Wabash, Ind., assignor by mesne assignments to Minneapolis-Honeywell Regulator Co. Pat. No. 1,664,325.

RELAY OPERATION INDICATOR. Harvey P. Sleeper, East Pittsburgh, Pa., assignor to Westinghouse Electric & Mfg. Co. Pat. No. 1,664,326.

THERMOSTATIC CUT-OFF. Arthur Stockstrom, St. Louis, Mo., assignor to American Stove Co. Pat. No. 1,664,331.

ENGLISH PATENTS

SLIDING CALLIPER GAUGES. M. A. Borel, Pontarlier, France. Pat. No. 282,708.

CALLIPER GAUGES. M. A. Borel, Pontarlier, France. Pat. No. 282,709.

CONTROL RELAYS FOR STEAM BOILERS. Siemens-Schuckert-Werke A. G., Siemensstadt, Berlin, Germany. Pat. No. 282,739.

ROENTGEN RAY STEREOSCOPIC APPARATUS. F. Bornhadt, Buchschlag, Hessen, Germany. Pat. No. 282,765.

SPEEDOMETERS. British Thomson-Houston Co., Ltd., London, England. Pat. No. 282,796.

ELECTRIC CLOCKS. Renard & Cie., Paris, France. Pat. No. 282,800.

SPEEDOMETERS; COUNTING REVOLUTIONS. L. A. Werner, Neuilly-sur-Seine, France. Pat. No. 282,837.

LIQUID METERS. F. Thorp and Parkinson & Cowan, Ltd., London, England. Pat. No. 282,855.

THERMOSTATS. N. H. Freeman, London, England. Pat. No. 282,864.

SOUND RECORDING AND REPRODUCING APPARATUS. A. A. Linsell, Essex, England. Pat. No. 282,906.

WEIGHING APPARATUS. W. H. Rees, Berkeley, Calif. Pat. No. 282,972.

WEIGHING APPARATUS. Day & Millward, Ltd., and H. Keach, Birmingham, England. Pat. No. 282,992.

SLIDE-RULES. Eyre & Spottiswoode, London, England. Pat. No. 283,003.

TENSION INDICATORS FOR ROPES. W. S. Smith, Harrow, Middlesex, England. Pat. No. 283,010.

LETTER SCALES. C. Mahlov, Virginia Heights, Virginia. Pat. No. 283,074.

IMPULSE SPEED INDICATORS. G. Mombur, Versailles, France. Pat. No. 283,100.

OPTICAL SOUND RECORDING APPARATUS. H. J. Kuchenmeister, Berlin, Germany. Pat. No. 283,108.

MULTIPLYING AND DIVIDING APPARATUS. C. M. Friden, Oakland, Calif. Pat. No. 283,137.

LOGARITHMIC CALCULATORS. H. P. Govare and F. M. Salomon, Paris, France. Pat. No. 283,175.

ODOMETERS. Kienzle Uhrenfabriken, A. G., Wurtemberg, Germany. Pat. No. 283,178.

ELECTRIC MEASUREMENTS. Trueb, Lauber & Co., Winterthur, Switzerland. Pat. No. 283,185.

ELECTRIC MEASUREMENTS. Compagnie pour la Fabrication des Compteurs et Materiel d' Usines a Gaz, Seine, France. Pat. No. 283,215.

REGULATING APPARATUS. Siemens & Halske, A. G., Siemensstadt, Berlin, Germany. Pat. No. 283,220.

TESTING WIRE ROPES FOR FLAWS. T. F. Wall, Sheffield, England. Pat. No. 283,256.

COUNTING APPARATUS. A. C. Brockies, London, England. Pat. No. 283,295.

SPEED INDICATORS WITH INDICATING APPARATUS. H. Bowyer, London, England. Pat. No. 283,322.

ANGLE-MEASURING INSTRUMENTS. E. W. Taylor, York, England. Pat. No. 283,346.

TORSION METERS. S. Shimizu, Tokyo, Japan. Pat. No. 283,386.

INTERNAL-COMBUSTION ENGINES. THERMOSTATS. J. Bowen, Swansea, England. Pat. No. 283,436.

CALCULATING-APPARATUS. Burroughs Adding Machine Co., Detroit, Mich. Pat. No. 283,486.

ELECTRIC MEASUREMENTS. H. J. Kuchenmeister, Berlin, Germany. Pat. No. 283,503.

LIQUID-DISPENSING APPARATUS. Gilbert & Barker Mfg. Co., West Springfield, Mass. Pat. No. 283,516.

TAXIMETERS. Ottico Meccanica Italiana Soc. Anon., Rome, Italy. Pat. No. 283,528.

ELECTRIC MEASUREMENTS. W. Kunze, Bremen, Germany. Pat. No. 283,538.

TESTING THE WEATHERING PROPERTIES OF MATERIALS. C. W. Ameson, Lombard, Illinois. Pat. No. 283,539.

MEASURING PUMPS. Soc. Anon. pour tous Appareillages Mecaniques, Seine, France. Pat. No. 283,570.

REGULATING LIQUID LEVELS, CONTROLLING FEEDWATER. E. C. R. Marks, London, England. Pat. No. 283,604.

ELECTRIC MEASUREMENTS. M. E. Simon and J. A. O'Connor, Berkeley, Calif. Pat. No. 283,650.

ELECTRIC METERS, PREVENTING UNAUTHORIZED ACCESS TO TERMINALS. D. E. Rees, London, England. Pat. No. 283,656.

TESTING PIPE JOINTS. D. H. B. Reynolds, St. Albans, England. Pat. No. 283,693.

ELECTRIC TESTS AND MEASUREMENTS. W. E. Boyd and T. Stewart, Glasgow, Scotland. Pat. No. 283,700.

TESTING MATERIALS UNDER REPEATED STRESSES. F. B. Dehn, London, England. Pat. No. 283,787.

Buyers' Guide

Instruments and accessories used for measurement, inspection or control in the industries and sciences.

If you are unable to find what you require in the Buying Section of Instruments—Industrial and Scientific, fill in the form on page 25 and we will obtain full particulars for you without charge. Give complete information of requirements.

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Recording
Bristol Company

ANEMOMETERS
B. K. Elliott Company
Taylor Instrument Companies

BAROMETERS
Aneroid, Mercurial, Recording
B. K. Elliott Company
Taylor Instrument Companies

CARBON DIOXIDE METERS
Tagliabue Mfg. Co., C. J.

CARBON MONOXIDE METERS
Tagliabue Mfg. Co., C. J.

COLORIMETERS
Tagliabue Mfg. Co., C. J.
Bausch & Lomb Optical Co.

COMPASSES
Otto Fennel Sons

CONSTRUCTION OF SPECIAL INSTRUMENTS
Schaerr, W. A.

CONTROLS, AUTOMATIC
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The Business Manager's Page

Each month the Business Manager will have a message on this page.

To the Instrument Companies:

In the March issue, this page carried the names of companies which were representative of more than 500 who placed a subscription for INSTRUMENTS. Since the mailing of our third issue, we have received over 300 additional subscriptions. It should be taken into consideration that these subscriptions came to us without a campaign other than sending a sample copy of the journal. This means that we are gradually building a quality circulation of readers who subscribe because they are interested in the editorial contents, and other departments of the journal.

Since the appearance of the first issue, the Readers' Service Department has received over 300 requests for literature, information on instruments, names of companies supplying different instruments and other information. These requests were answered promptly whenever possible, in some instances though the question was passed to some of our collaborators, in which case a slight delay resulted. The patience of our readers seeking information has helped to make pleasant what would otherwise be a heavy burden.

Requests for reprints of articles appearing in the different issues is another interesting side light, and shows that information appearing in INSTRUMENTS is authoritative.

Many letters of appreciation and approval of our efforts have been received from our readers, a few of these have found their way to the Readers' Comments Page. Also some of our advertisers have expressed their satisfaction of INSTRUMENTS as an effective medium for transmitting their sales message. We are pleased with these letters for they make the work lighter and more pleasant.

We realize that this is but a beginning, also that rendering a service to users and manufacturers of instruments is no small undertaking. How well we are succeeding can only be measured by the results we have obtained.

We have the support of instrument users, and believe we merit the support of every instrument company by their representation in the advertising pages. It is to your best interests as an instrument company—it is YOUR publication.

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INSTRUMENTS

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THE instrument requirements of Industry and Science are vast and varied. New problems in measurement, inspection, and control in manufacturing are always arising. Engineers, Works Managers, Superintendents and Scientists, seeking to improve modern industry's methods are constantly searching for instruments to satisfy such demands.

INSTRUMENTS, the only American Instrument Journal, is a monthly publication devoted to the instrument problems of all industries. It will serve as a source of worthwhile information on every advance in the field of INDUSTRIAL INSTRUMENTS and their use for the improvement of the efficiency of industrial operations. This periodical will therefore be indispensible to Works Managers, Engineers, Research Laboratories, Test Engineers, Routine Laboratories, Consulting Engineers, Schools, etc. It will be the standard book of reference for all those engaged in:

1. Production in which instruments are used for measurement, inspection and control.
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Below are standard file cards, which the editor believes will be a valuable asset to you personally. These cards will be bound in each issue of Instruments and will cover the original articles contained in that issue. The color of the card and ink to be used is shown here. This will facilitate distinguishing the INSTRUMENTS FILE CARDS from others with which they might be consolidated.

The editor suggests that these cards be carefully cut out immediately on receipt of INSTRUMENTS and filed in your desk or in a file box on top of your desk. You will then have within easy reach an index of instrument information of incalculable value.

The card is arranged with a space for classification subject or number at the top. Suggestions as to classifications for the cards below are:

INSTRUMENT PIONEERS
AIR-CRAFT INSTRUMENTS

INSTRUMENT PIONEERS—GALILEO GALILEI (1564-1642)

INSTRUMENTS, Vol. 1 No. 4, April, 1928, pp. 171-174, 1 fig.

A brief history of Galileo's life.

WHY NOT BUILD AIRCRAFT INSTRUMENTS?

BRADLEY JONES, INSTRUMENTS, Vol. 1, No. 4, April, 1928, pp. 175-177, 1 fig.

The need for instruments is pointed out. The increase in the use of instruments on aircraft is mentioned. From the crude airspeed indicator of the Wrights and Curtiss to the eleven instruments now on a well equipped instrument board, is briefly mentioned. The Government requirements on aircraft instrument equipment is given. The article is a plea to instrument manufacturers to consider taking up the building of aeronautical instruments.

Illustrated above is the new Tycos Direct-Set Recording Regulator.

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